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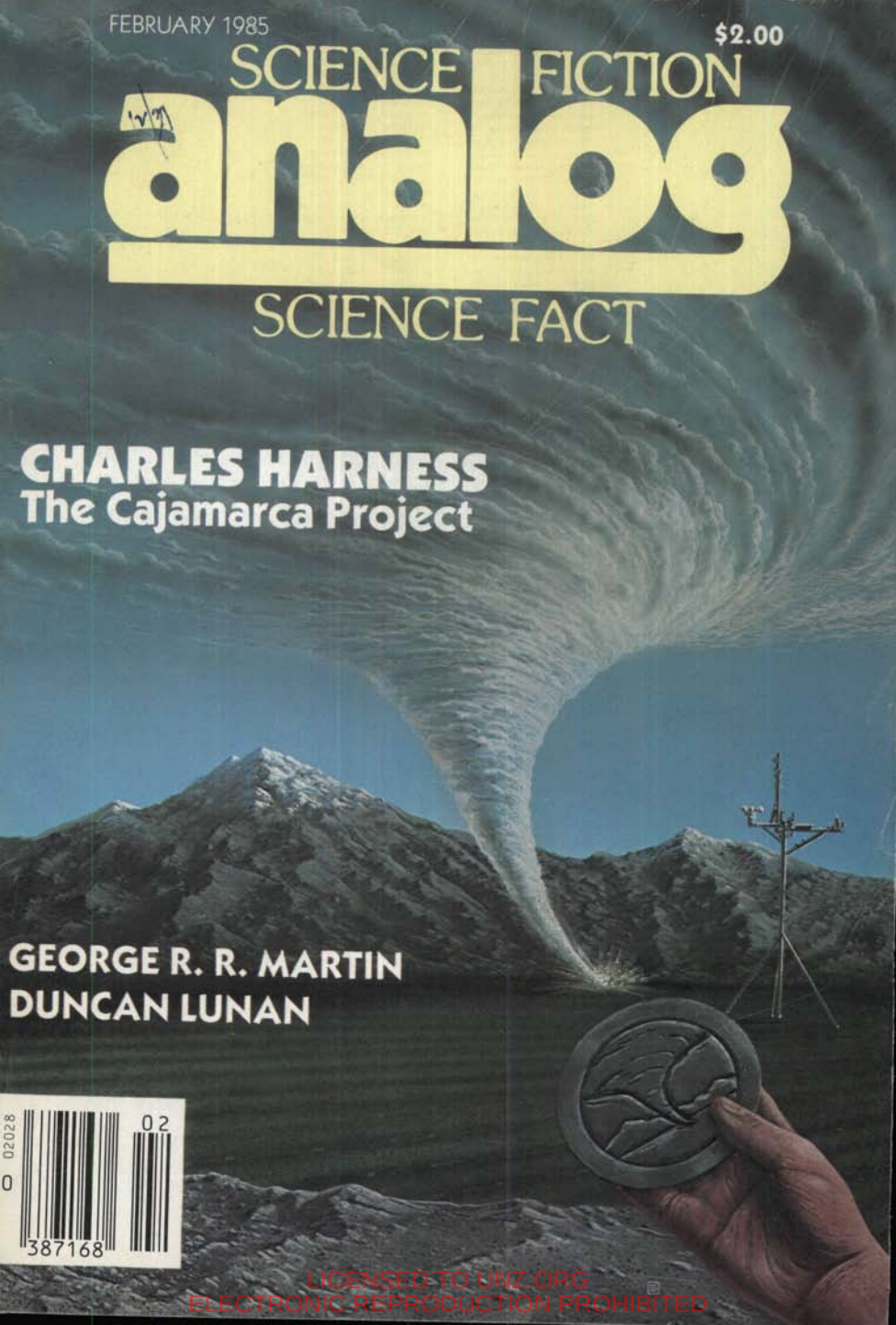

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Editorial

ACID RAINDROPS

Stanley Schmidt

"Amendment xxxi: The first through tenth articles of amendment to the Constitution of the United States are hereby repealed. Congress shall have power to restrict and regulate the exercise of speech and the press, the practice of religion, and assembly of citizens, in whatsoever manner it may deem necessary to the security of the Nation and the respective States. Congress shall pass no law which would restrict searches and seizures and thereby interfere with a speedy trial in any criminal prosecution, or forbid law enforcement agencies to exact full and complete testimony from all witnesses including defendants. . . . Nothing in this article shall be construed to limit the right of the respective States to impose additional restrictions beyond those legislated by Congress. . . . All rights and powers not expressly reserved to the people shall be subject to the control of the States except insofar as they are regulated by the Constitution or by laws passed by Congress. . . ."

Couldn't get away with it, could they?

Assuming that such an amendment could somehow be pushed through Congress, I don't think the item above would have any chance of ratification. (Would it?) Such a blatant attempt to do away with all constitutional protections of civil rights would meet with well-earned howls of righteous wrath and indignation. Even our relatively docile public (I think and hope) would

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not sit still for a single action that so overtly took away so much of the freedom they had taken for granted.

Ah, but a lot of *little* actions, each seeming too small to worry about and each supported by its own special justification . . . that's a different matter. Consider just a few examples from the recent past, of actions which *have* won at least a significant degree of acceptance. (I'm happy to report that each also met at least some opposition—but the point is that it got far enough for the controversy over it to be a matter of public concern and uncertain outcome.)

●New York State is officially very proud of having recently become the first state in the country with a mandatory seat belt law for drivers and front seat passengers in private cars. Civil liberties groups have drawn inevitable (and apt) comparisons with *1984* since the measure seems to them a clear case of government intrusion into an entirely personal and private decision. One supporter of the measure responded by saying something to the effect that if ever there was a case where "Big-Brotherism" was justified, this was it. Others who have tried to give a more closely reasoned defense of the measure have pointed out that it will save many lives. That is almost indisputably true, but is it the issue? (Required reading for those who think saving lives is a paramount consideration: Jack Williamson's "With Folded Hands . . .") I somehow grew up with the belief that the principal function of government was to protect individuals from each other, not from themselves. Protecting myself from my own actions was *my* responsibility (and right). Requiring someone to wear a seat belt is a clear case of government's dictating an action by an individual which has no direct consequences for anyone else. Since he bears the full consequences of the action, he logically should bear full responsibility for the decision. Yes, I know there are indirect consequences—someone who is injured or killed because he did not buckle up may occupy a hospital bed, create hardships for his family, contribute to an increase in insurance premiums, etc. But *every* action has indirect as well as direct consequences, most of them not accurately predictable. If the worst possible ripple effects are invoked as justification for forbidding actions, there is little that *cannot* be forbidden.

●Several states are trying to raise the minimum drinking age because statistics clearly show that many accidents involve young drunks. So again we hear the argument: it will save lives. And again, almost certainly, it will—but does that justify it? Let's carry the statistical argument a little further. Yes, getting alcohol out of the hands of all eighteen-year-olds will reduce DWI problems by getting rid of eighteen-year-old drunk drivers. But that statement is also true if you replace eighteen by any other number. *Any* group that is prevented from drinking will reduce traffic deaths by getting a subset of drunk drivers off the road. Raising the drinking age to eighty would reduce them a lot more than merely raising it to twenty-one; does that mean it's bet-

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ter? The logical extrapolation of the "it will save lives" argument here is absolute prohibition—and if you remember history,,you know where *that* got us. For that matter, we could effect an even bigger reduction in traffic fatalities by raising the *driving* age to twenty-one or sixty or a hundred. After all, sober drivers have accidents too, and every little bit we can shave off the statistics helps. So what if nobody is able to go anywhere?

It's true that drunk drivers, unlike seat belt abstainers, endanger others as well as themselves. But wouldn't it be better, even if harder, to find a way of going after *drunk drivers* regardless of age, rather than *young people* regardless of their drinking and driving habits?

An interesting sidelight on this particular issue is the effort in Washington to coerce states into legislating to federal specifications. On paper, it's a state-by-state issue—but there are those in Congress who want to make federal aid, for which states would otherwise be eligible, depend on their having passed the kind of laws Congress would if it could. It's like those "voluntary" guidelines we get from time to time before a gov-

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ernment resorts to legislation. It's also like something many of us have heard one time or another as children: "I won't make it a rule, as long as you voluntarily do what the rule would require if I did." Such a statement makes a mockery of the words "voluntary" and "freedom." *Real* freedom of *X* means you're free to do it *your* way—*regardless* of whether I approve.

●I recently read of an incident wherein the valedictorian of a California high school refused to deliver her valedictory speech (ironically titled "Images of Orwell") because her principal had insisted that she delete one page which made discreetly critical remarks about the school. He was quoted in the account I read as saying, "I don't think it had anything to do with freedom of speech. There's a fine line between censorship and asking, 'Hey, do you think this is the time or place to say these things?' " I'll grant him that that's a legitimate question to *ask*, but the line between that and censorship doesn't look at all fine from here. He can *ask* the valedictorian whatever he wants—but if her answer is, "Yes, I think this is the time and place . . ." and he makes her take it out anyway, *that's censorship*, pure and simple. Period—just like the period at the end of the First Amendment, which does *not* say, "Except when somebody doesn't like what you say." Once you let somebody draw a "fine line" and say, "Free speech does not mean this. . . ." it becomes awfully easy to let somebody else use the same kind of reasoning to draw another one a little further on. And pretty soon free speech doesn't mean *anything*.

●Another "fine line" was recently drawn by legislators in Indianapolis, who passed an anti-pornography law allowing "any aggrieved woman" (as *The New York Times* put it) to file a civil action to prohibit the showing of certain movies and force removal of books and magazines from bookshelves. Last I heard, the ordinance was being challenged in a federal court; it may be out by the time you read this, and I won't try to predict the outcome. What matters is that it generated enough support to *become* law, whether or not it is ultimately upheld as such.

The Indianapolis law is fairly explicit in its definition of pornography, and I'm sure I would find much of what it's aimed at highly distasteful at best. But I would not consider it my right to *ban* what I dislike, and my idea of pornography may differ significantly from that of anybody who helped pass this law. The language of the law is, by the nature of the problem, somewhat vague—but as I read it, it seems to rule out the mere description, with or without approbation, of whole categories of characters and relationships. It would, according to one lawyer contesting the law, rule the entire James Bond series "pornographic." Whether it would actually go that far depends on the views (and moods) of judges, but it would certainly force producers and sellers of books, magazines, films, and tapes to be very wary of offending the hypersensitive. Who is "hypersensitive"? The very essence of the problem is that that question can't be answered in a way people can

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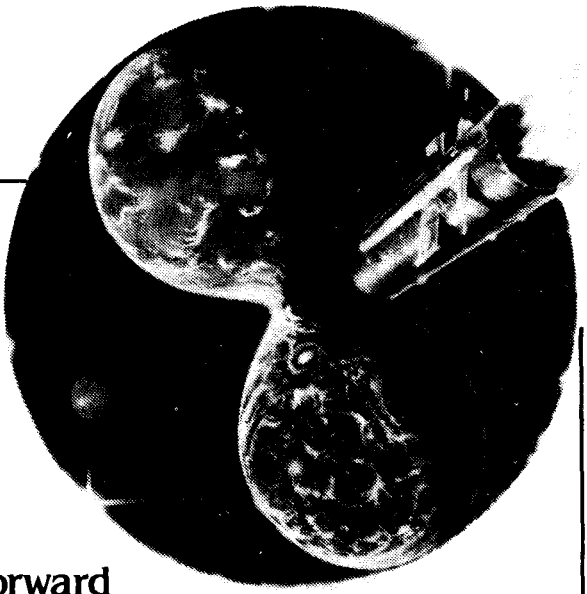

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agree on. The only way to avoid setting dangerous precedents is to avoid the pretense that words like "pornography" lend themselves to objective enough definition to allow legitimate exceptions to freedom of speech—even if you accept the idea that some forms of the stuff are Truly Evil. I do recognize a concept of pornography, and it's something I don't like. But I know and respect others whose criteria for defining it are quite different from mine. I refuse to let their standards dictate my choice of reading matter, and I must grant them the same consideration. Otherwise we will have legislators and courts making a quite persuasive exception for *this*, and then another for *that*, and before we quite realize how it happened, we'll find that we've let ourselves be quite thoroughly fenced in.

I could go on, with examples drawn from such intriguing areas as recent rulings on illegally obtained evidence and the special *de facto* privileges of IRS agents, but I think I've been through enough to make my point. The legislators who want to look over your shoulder in your private car, the principal who "despises censorship" but feels free to ban a page of a graduation speech, the legislators who feel they must stop pornography at all costs—all of these people, as nearly as I can determine, honestly believed that what they were doing was right. Even though it represented an intrusion of government upon individuals beyond what was previously accepted, they sincerely believed the circumstances were special enough to warrant such encroachment, to serve a "larger good." And in each case they found enough people who agreed with them to gain at least temporary victories. Even many people who did not actively support them shrugged these instances off as "unimportant" or "special exceptions for special cases." Some examples may even *be* special enough to justify exceptions—for example, I suspect we do need at least some protection against libel and slander.

The trouble is that a lot of special cases—a little chip off freedom for this one, a little for that one—can add up to a lot of damage. No one of these cases may actually be important enough in itself to justify, for most people, a great deal of resistance. But when a change that would be quite intolerable if delivered in one obvious blow is brought about by a series of small changes, no one of them shocking enough to provoke much reaction—how does a person (or a people) decide when it's time to say, "No more!"?

A single raindrop, even one heavily laden with corrosive impurities like industrial acid, makes very little difference in a landscape. But if enough of them fall, the result may be the Grand Canyon. ■

● Life must be lived forward, but can only be understood backward.

Kierkegaard

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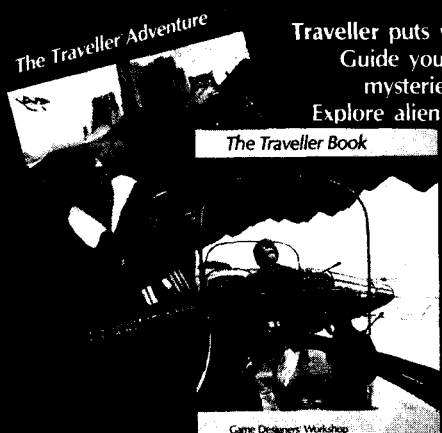

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The client was clearly
mad—but any researcher
must remember that the variables
he's studying are not
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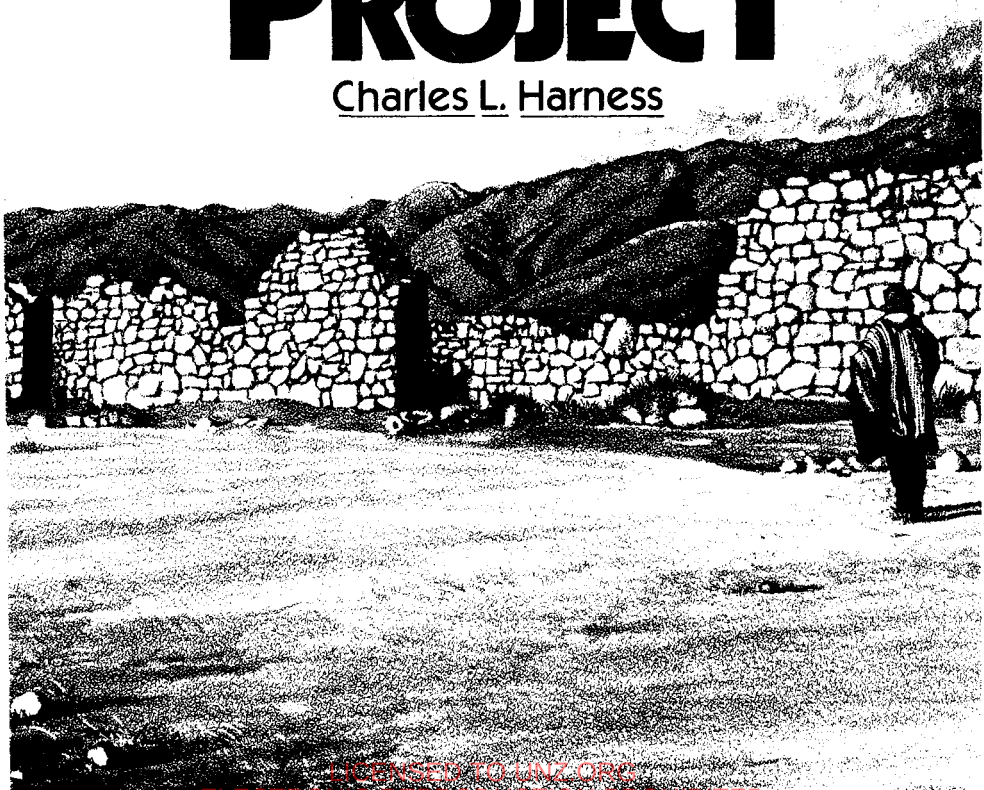
CAJAMARCA PROJECT

Charles L. Harness



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1. Maria

I noted right away that the Administrator was being extremely deferential and polite. This petite woman radiated wealth and power. She sat regally, as though holding informal court. "Señorita Doctor Antis," said the Administrator, "may I present our chief biochemist, Dr. James Ruiz."

Without rising from her chair, she

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smiled faintly and nodded.

I bowed and took the chair indicated by the Administrator. While he briefly extolled my expertise and accomplishments in genetic engineering I studied her from the corner of my eye.

Dr. Antis was beautiful in an unsettling way. She was full-chested, but I could see this was probably due to unusually large lungs rather than to large breasts. Her hands seemed small and the fingers stubby. She wore no makeup; her cheeks were apparently naturally ruddy. Her eyes troubled me. A barely visible epicanthic fold traced each upper eyelid. I had seen the same look of deadly beauty on a creature in the Washington zoo: namely, a cobra. What did it all add up to? I thought I knew. She was a daughter—a princess—of the high mountains. Perhaps the Andes, or Tibet, or the Himalayas. They had evolved differently from us lowlanders.

Back to Earth. The Administrator was talking to me. "The Señorita Doctor represents a group known as Atahualpa Associates—A.A.—with headquarters in Trujillo, Spain and branches in Peru. She has presented a very interesting problem. A.A. wants a nitrogen-fixing bacillus."

I didn't get it. "There are plenty around already. They grow naturally, on practically all the legumes . . . soybeans, lespedeza, sweet clover, alfalfa."

She shook her head. "Oh, that's quite true, of course." (She had a very faint accent.) "In fact, nitrogen-fixing microorganisms supply two-thirds of the nitrogen used world-wide by food crops. First, as I'm sure you know, the bacillus makes ammonia, which is quickly oxidized to the nitrate, and is then assimilated successively into nucleic acids, proteins, and chlorophyll. Unfortunately, each bacillus is specific to a given plant. We want a bacillus that does not require a specific host plant. For example, *Rhizobium japonicum* fixes a fair amount of nitrogen, but only as nodules on the roots of alfalfa. We would like one that will fix an immense quantity of nitrogen anywhere, in any soil, on any crop."

"What do you think, James?" said the Administrator.

I was thinking it would take about a thousand years and a million man-hours, and that the man who synthesized such a bug ought to get the Nobel in chemistry. I shrugged. "We might do some preliminary work, just to get an idea of the dimensions and possibilities. If it's clearly impossible—"

He cut me short. (The lab existed to make a profit; my salary wasn't paid by projects that were quickly proven hopeless.) "What he means, Señorita Doctor, is that we cannot guarantee success, and that the project will be expensive." He looked at me again.

I wasn't stupid. I picked it right up, having due regard to her very expensive black wool business suit, and her jewels, and especially how she carried herself. "For openers I would recommend a year at the bench, one in the greenhouse, one in the field."

"How much?" she said bluntly.

The Administrator touched his fingertips together and leaned back in his swivel chair. He would now demonstrate why he sat where he sat, and why I sat where I sat. "To start, a retainer of one million U.S. dollars, current gold

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equivalent."

She wasn't shocked. I got the impression he could have said ten million. "Progress reports?" she said quietly.

"Quarterly. Plus lab access and discussions at any time."

"Agreed. You will start immediately. The retainer will be in your bank this afternoon by EFT. A.A. will identify this and subsequent payments under the code name, *Respuesta a Cajamarca*."

" 'Reply to Cajamarca?' " murmured the Administrator. He and I exchanged puzzled glances.

Our ignorance amused her. "In South America every schoolboy knows Cajamarca. It's a place in the Andes. There, on November 16, 1532, Francisco Pizarro treacherously kidnapped the Inca emperor, Atahualpa, and thereby stole an empire. Okay?" (She pronounced it 'haw-kay.')

"Yes, of course," agreed the Administrator (I read him clearly: it's her money. She can call it anything she wants.)

She said, "When can you start?"

"Tomorrow," said the Administrator, without even a glance in my direction.

She frowned. "Today would be better."

I shook my head. "I have nothing to start on. I will have to gather samples . . ."

"Begin with this." She opened her little leather case and pulled out a plastic jar. "It's a special mutated strain of *Rhizobium japonicum*. It already has certain of the characteristics we seek. We call it simply Fifteen Thirty-three."

"I'll log that in," said the Administrator. He took the jar.

I said, "Let me see if I understand. In the standard process the cell first synthesizes ammonia. A second bacterium, *nitrosomas*, oxidizes the ammonia to nitrite, and this is oxidized in turn by a third bug, *nitrobacter*, to the nitrate, which the plant can finally use. Your mutant Fifteen Thirty-three is to be a foundation. You want the three functions, ammonia, nitrite, and nitrate built directly onto that foundation, so you'll have everything in one cell. The overall would be one oxygen plus two nitrogens plus two waters gives one molecule of ammonium nitrate."

"Exactly, Dr. Ruiz." She gave me a beautiful smile. "You see? Not so difficult!"

Hah! I thought. But I smiled back.

"And I'll return now to Dulles," said our new client. "My plane to Lima doesn't leave for several hours. Perhaps Dr. Ruiz can drive back with me, and we can talk in the car?"

"Of course." I jumped up. "I'll bring my car around to the front."

"No. I rented a machine at the airport. I have to return it."

"Fair enough. We'll take yours."

Another surprise. Her rental was a chauffeur-driven black Mercedes. I joined her in the back seat.

There was something odd about the chauffeur. Mainly, it was his hat. It wasn't the ordinary black hat with brim and bill that one would expect a chauffeur to wear. It was a strange close-fitting knit thing with earflaps. Dr. Antis noted my interest. She whispered, "That's a *chullo*. It's a native Peruvian cap, worn in the Andes. Manco is one of our Associates."

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That explained it. This dark-skinned man was not just a driver. He was also here to keep an eye on the lady. To protect her? To make sure she carried out her assignment? Oh well, none of my business.

"Your specimen number Fifteen Thirty-three," I said. "Does that mean it was number one thousand five hundred and thirty-three in a series of experiments?"

"Oh no. We did some preliminary work, and we had mostly failures, but Fifteen Thirty-three isn't a number in that kind of series. It means simply the year 1533."

"Something happened in 1533?"

She was suddenly very serious. "Really, Dr. Ruiz, you should read up a bit on South American history. In 1533 the Conquistadors strangled Atahualpa, the last of the Incas."

Hm. A.A. means Atahualpa Associates. Cajamarca means the place where the Spaniards bushwhacked Atahualpa. She's got a neurosis on this historical stuff. Why? All this was five hundred years ago. What if I told her one of my ancestors was Pizarro's chief navigator? Would she cancel the project? It was a long walk back to the lab. Let's move on to happier thoughts! "If the project succeeds," I said inanely, "it will benefit all mankind."

I think she smiled. I couldn't tell for sure. Had I said something funny?

"What *is* your object?" I blurted. (I was never famous for tact or diplomacy.)

"To help the mountain people."

As I watched the scenery flow by on Dulles Access, I thought about that last statement. There was something in the way she said it that meant *'only* the mountain people.'

She supplied the tact I lacked. "What was your last project? Or is it confidential?"

"No, not confidential. Quite the contrary. It was for the U.S. Department of Agriculture, and the report will soon be available from the GPO. Actually, taken *vis-a-vis* your project, it may seem amusing. Instead of developing a superbug to draw nitrogen out of the atmosphere, I developed a superbug to return nitrogen from the soil to the atmosphere."

"Indeed? Whatever for?"

"The object is simple enough. Synthetic nitrate fertilizers frequently leach out of the farmer's fields and into wells and reservoirs. Nitrate in excess of 10 ppm may be dangerous in drinking water. High nitrogen fields treated with my De-nitro release their nitrogen as free vapor back to the atmosphere."

She was polite but not particularly impressed. "Denitrifying bacteria have been around a long time, probably since the Archeozoic. They're a fundamental segment of the nitrogen cycle."

"Mine is faster, much faster," I said. "De-nitro breaks up the nitrogen in a

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fraction of the time required by natural stock."

And now, very suddenly, as though I had struck a nerve, she was all attention. She faced me quickly. "What is the equation?"

"Ammonium nitrate gives nitrogen, oxygen, and water. The exact reverse of yours."

"And you say it is very fast. How did you accomplish that?"

An odd question, but I saw no reason not to answer. "I discovered how to accelerate RNA transfer at certain crucial points in the enzyme cycle. Mitosis is almost explosive."

"Interesting," she murmured. But now she had completely recovered, and she was looking away, as though it wasn't interesting at all. "I suppose there are other ways to accelerate mitosis?"

"I suppose."

"Such as . . . ?"

"Oh, I don't know. A mutant? A wild gene lying dormant in the base stock? But I shouldn't think you'd want it to be too fast. I assume your Fifteen Thirty-three already has an orderly, predictable nitrogen pickup and release." I put it as a question.

"That is so."

"And of course you will want me to keep it that way. The thing we're looking for now is universality. Something you can put on any crop, especially corn."

"Of course."

(She had agreed quickly, so quickly in fact that I wondered if she had really been listening to me.)

The limo had stopped. We were at the Pan Am entrance. "You have an hour and a half," I said. "Why don't we try the bar?"

She hesitated. "We Indians have a low tolerance for alcohol. How about the tea room?"

"Of course."

And so up the stairs.

2. Tea at Dulles

"Antis . . . strange name," I said. "Not Spanish?"

"No, *Indio*. In the *quechua* language *anti* means high mountain. Specifically Antis means the Andes. That's how the range was named."

"So you're a native Andean?"

"Yes. I was born in the Peruvian sierra, at five thousand meters—over fifteen thousand feet."

"The air must be pretty thin."

"About one-half atmosphere. But evolution has adapted us. Our lungs and hearts are bigger. We have twenty percent more blood than you lowlanders, and our blood is more viscous and has bigger cells. We are smaller, which means less body surface to lose heat. We have a fine time at fifteen thousand feet."

"I don't think I would."

"No, you'd get sick. They call it *el soroche*, altitude sickness. The slightest exertion would exhaust you. If you were very old or very young, you would probably die. Lowlander newborn risk brain damage at one-half atmosphere, caused by lack of oxygen." And now she studied me a moment. "Do you have any idea what would happen if the air pressure in the lowlands all over the world were suddenly reduced to one-half atmosphere?"

"I could guess. But tell me."

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"It would be just as I have described, only worse. The old and young die. The social fabric disintegrates. Terror, anarchy, chaos. Toward the end, only a few million of the strongest would be left. And then the mountain people would come down into the lowlands. They would inherit the destruction. They would come as hunters, and gatherers of wild crops. They—only they—would possess the skills and the physiques needed for survival in such a world." Her eyes were burning.

I gulped. She was dead serious. I stared at her, and I think my jaw must have dropped.

That made her laugh. "Ah, James, I think I have alarmed you. Let us talk of more cheerful things."

She called me by my Christian name. I decided I liked that. "May I call you Maria?"

"Please do. So let us plan. Our crops in the Andean sierra are mostly maize—you call it 'corn'—and potatoes. The new fertilizer should give taller maize, bigger potatoes, more of everything per hectare."

"Let's see—your growing season is all turned around."

"True. We plant in September. The maize ripens in April, we harvest it in May. In June we dig potatoes."

"Rain?"

"A little in November. We collect it in reservoirs and distribute it in irrigating canals."

"As soon as we get a candidate superbug out of the fermenters, we ought to try it on a few acres in your sierra."

"Of course. And after that, in the Estremadura."

"The—*where?*"

"In Spain, near Trujillo, where the great Conquistador Pizarro was born. We have four thousand hectares there." She regarded me with dark cryptic eyes.

There was something important here, and it was going completely over my head.

She said, "Which would you test first, corn or potatoes?"

"Corn, I think. Edible for both man and beast."

"You have experience with corn?"

"Of sorts. I was born on a smallish farm in Iowa."

"And you grew corn there?"

"We had three hundred acres, all in corn. It was all done by machinery—fertilizing, planting, cultivating, harvesting. The tassels stood way over my head. My sister and I played hide-and-seek in the rows. You could get lost."

"Sounds like a good life."

"Yes. I remember, when I came home from college that first summer, I was out in the field and it was raining." I stared up at the high ceiling and my voice grew softer. "The corn-leaves are cupped against the stalks so as to catch the water. I watched them drink. I lifted up my arms, and it rained on me, and on the corn, and I could smell the wonderful wet earth, and I was so happy I wanted to cry. Maybe I cried a little." I cleared my throat gruffly. "That's all very silly, isn't it?" I stood up without waiting for a reply. "They're calling your flight. Better get out there."

"No. Not silly. I am glad for your happiness." We shook hands. She smiled and said, "I wish everyone could be happy, all the time. But that is not possible. Goodbye, James. I think I will be

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seeing you again, very soon. *¡Hasta la vista!*"

"*¡Feliz viaje!*"

I stared after her. What drives you, Maria Antis? What is this mysterious revenge you seek? You would destroy Pizarro and all his crew. But they're already dead, Maria. In their graves for half a millenium. Don't do it, Maria. Whatever it is, don't do it.

3. Back at the Lab

It was so easy it bordered on the ridiculous. Maria Antis's *R. japonicum* Fifteen Thirty-three proved to be the perfect base bacillus. *Jap*, of course, is a great nitrogen-fixer all by itself; it grows on the root hairs of legumes such as soybeans, clover, alfalfa, and so on. In America in the old days the farmer would rotate sweet clover and corn just to get the nitrogen left by the clover. And world-wide, most crop nitrogen was still supplied by *jap* and his cousins. That was because synthetic ammonium nitrate was so expensive. Maria was right about the cellular mechanism. Oxygen plus nitrogen plus water gives ammonium nitrate, stuffed neatly into the bug cells. If you slice open a nodule on a clover rootlet, the bacteria pop out. They're puffy little strings. At three thousand diameters they look like strips of fried onion. The object was, get them out of the nodules and persuade them to proliferate through the soil quickly. And they would have to be compatible with any crop—especially corn—during the growing season. If I could accomplish that, I could double—*triple*—the acreage available for grain production in many areas of the world.

As a start I microinjected DNA from Maria's Fifteen Thirty-three into a cell of *Escherichia coli*. *E. coli* is a commonplace selection for gene splicing. It multiplies at a terrific rate—doubles about every half-hour. In twenty-four hours you get 2^{48} cells: three hundred thousand billion. My chimera was even more vigorous. And it was motile: in preliminary tests it *spread* through the soil particles at the rate of several meters a day, all the while drawing nitrogen from the atmosphere. Next I spliced in the functional genes of *nitrosomas* and *nitrobacter*. In the end I had in one bug the complete nitrogen function: atmospheric nitrogen to soil nitrate.

"So much for the test tubes, James," said the Administrator. "I think you are ready to try it under severe natural field conditions. What do you think?"

I hesitated. "Suppose it mutates? Suppose it goes wild?"

"It won't."

"You're not concerned about the possibility of explosive mitosis? We got that with De-nitro, you know."

"All the better! You'll get double the amount of Fifteen Thirty-three in the same time period."

"That's a lot of bugs. And everyone of them drinking in the *nitrógena*." I made an unhappy face. "Maybe we should wait a bit. Maybe we should incorporate a mitosis-rate governor."

"Which doesn't yet exist."

"No."

"So there you are." His mouth took on a grim edge. "She called yesterday. She's satisfied. No more bench work. She wants us to move into the field—immediately." He clasped and unclasped his hands a few times. "James, she wants you to come down to Peru

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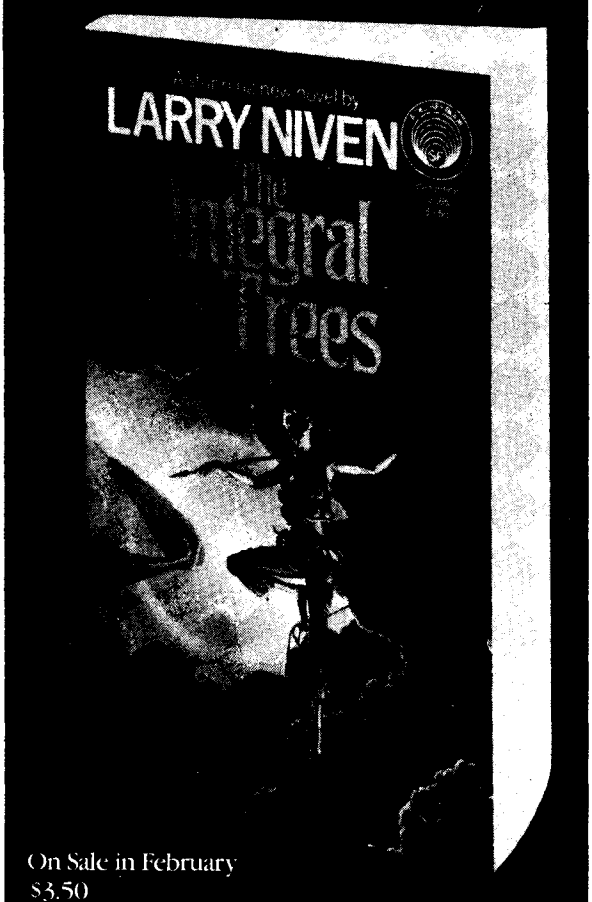

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and spread Thirty-three on a hectare of *Zea mays*. Corn. You know corn. The land's plowed and waiting. They normally plant next month—September."

"But—"

"Glad you agree. You're on Pan Am to Lima tomorrow morning."

4. Lima

And so we spread the Fifteen Thirty-three and planted the cornseed at the beginning of the Peruvian summer. And I was glad when it was all over and I could leave the high country and navigate the hairpins back down to Lima. The thin mountain air was killing me. Every morning I had awakened dizzy and with a headache, and I was nauseated at the thought of breakfast. Maria Antis thought it all very funny. "It is merely *el soroche*, James."

At the end of the week she returned with me to Lima. Tomorrow I'd take good ole' Pan Am back to Washington, D.C. and a little peace and quiet.

"Next time," she said, "you'll have to go up into the mountains in stages. Spend a week at five thousand feet, another at ten thousand, and so on. When you get to fifteen thousand, you won't be quite so sick."

I groaned.

She continued amiably. "Now then, as long as we're in town, we might stop by our little lab. You can see where it all began."

"Fine with me."

The A.A. laboratory in Lima was a modest affair: a tiny office, three work rooms, and a storeroom. Save for one mean-looking *chullo*-capped character, evidently a caretaker, the place seemed deserted. Dust was gathering on the benches and reagent bottles. "Actually," said Maria, "we pretty much closed down when we found Fifteen Thirty-three. Before that, though, I spent many hours at these benches."

Just then there was a noise out front, and a moment later Hard-eyes came into our room, held a brief conversation with Maria, then left. "Coya speaks only *Quechua*," she explained simply. A moment later Coya pushed a loaded warehouse cart through the lab room toward the door to the storeroom, which was apparently locked. From a peg by the door he took a gleaming metal disc hanging there by a filigreed chain, and thrust the disc into a slot in the door. The door slid into the wall. He rehung the disc and pushed the cart into the storeroom. I caught a glimpse of the interior. It held rack after rack of gas cylinders, laid horizontally like wine bottles. There must have been a thousand. What gas? How did she propose to use them? Very strange! "What is all *that?*" I demanded.

"Oxygen."

"What?"

"*Cilindros de oxígeno.*"

"But whatever for?" I could not imagine any normal genetic engineering use.

Now she became oblique. "They are for a certain contingency. Let us say, suppose the air pressure should fall here to one-half atmosphere. Let us say there is a person who is not accustomed to such low pressure and who for this reason may become very sick, perhaps even die. But suppose he is able to get to this place. He unlocks the door with the disc key, and inside he finds breathing masks and plenty of oxygen. He can

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use the oxygen, and so become adjusted over the next few weeks. He will live."

Maria, I thought, you ought to be in an institution.

"You think I am crazy? *Maria la loca?*"

"Certainly not," I lied. "On the other hand, I don't think the world will suddenly lose cabin pressure. The atmosphere has been with us a long time."

She looked at her watch. "Since we seem to be in no immediate danger, how about some lunch? Shall we go downtown?"

During the drive into town I kept thinking about those oxygen flasks. Sane or not, Maria was a purposeful woman, and those things were there for a purpose. Not just a contingency. Not for an improbable emergency. Somebody was actually going to need them. Maria, what in the devil are you up to? Bug Number Fifteen Thirty-three is vital to your scheme. How? So am I. How? I'm on to you, beautiful lady. Sooner or later I'll trap you.

We sat at tea in the Rotunda of the Gran Bolivar Hotel, near the street, sipping *yerba maté* through those neat little fiber filters. Idly we watched the stream of noontime people: some in routine office attire; some in peasant cloak and dress, including those strange derby hats. A lot of the women bore a physical resemblance to Maria. I said to her, "You and your people have an evolutionary edge on us, with your big lungs, and all. Where did you come from, long ago, I mean?"

"Well, we go way, way back. Twenty thousand years ago, as the climate warmed and the enormous northern ice cap began to melt, great herds of caribou—I think you call them reindeer? —began to migrate out of Mongolia. Some moved north, and crossed the land bridge into Alaska. Some moved south, into Tibet and Nepal. My ancestors followed the herds. My people had by then become pretty well adapted to high altitudes and the cold and the thin air. My forebears migrated southward down through the Cordilleras, into Mexico, through Central America, and finally into the Andes. They lived peacefully, and they prospered. They farmed productively. There was food and shelter for all. Then, in 1532 the Spaniards came to the Andes. Things have never been the same since."

When she talked this way I became uneasy. To change the subject I pointed toward the street, at a young woman in a derby hat carrying an infant in a shawl on her back. "The baby's sitting on something," I observed.

"Dynamite," said Maria dryly. "She's a courier for the local revolutionaries."

I couldn't think of a reply.

But she was not at a loss for words. "We no longer own our souls. As your great historian Prescott said, we are aliens in the land of our fathers. That woman you saw . . . she was quite properly bitter. But she's going about it the wrong way. Others go in for prayers and incantations. That's wrong, too. Not so far from here, in the heights overlooking La Paz, the Indians celebrate what you'd call a Black Mass. That's stupid. The Black Mass will never re-conquer Bolivia. It's like the Ghost Dance in your country, when the

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Indians thought that hopping around and dancing and chanting would drive the white man back to Europe. That's not the way to do it either. The way to do it is to get the white man to do it to himself."

"Now look here, Maria! I didn't do any of those bad things to the Indians, and I refuse to feel guilty. So knock it off!"

She looked at me in astonishment. Then she laughed merrily. "Not guilty, says dear James! Of course not! But can you say so much for your ancestor, Bartolomé Ruiz, Pizarro's navigator?"

"No fair!"

"*No importa*. Never mind." She leaned forward. "Now we must make plans for your return at harvest, next May. You'll come back then?"

I had to see this lunacy through to the end. I grinned. "To see you again, I'll be here."

"How gallant! And on your return, you'll go up the mountains in style. And perhaps we can make a little side trip, up in the peaks."

My smile froze. I was suddenly suspicious. "What for?"

"You want to see how Atahualpa Associates is financed? Where we get our money, with which we pay your salary?"

"Well, it's not any of my business, really."

"I assure you, dear James, it *is* your business. You are *deeply* involved."

She loved her mystery.

I shrugged. "Well, okay, then."

5. The Cornfield

And so came harvest-time, and Maria and I and a gaggle of reporters looked down into the valley at that green field, my brainchild, my masterpiece. As it turned out, Thirty-three had provided more usable nitrogen than any of the synthetic (and expensive) nitrogens we had tested as controls in adjacent plots. Ours gave twice as much corn as urea, three times as much as ammonium nitrate. Besides which, commercial manufacture of Thirty-three would be almost as cheap as dirt. A ten-peso thimbleful inoculated an entire hectare. And there it would proliferate quietly, year after year. Other nitrogen-fixing bacilli required specific host plants: clover . . . alfalfa . . . and the crop had to be plowed under to utilize the nitrogen nodules. But not Thirty-three. It grew anywhere, with or without a crop. We knew that from lab tests. It would work for rice in Malaysia, potatoes in Idaho, sugarcane in Trinidad, wheat in the Ukraine.

"What next, Dr. Ruiz?" asked the man from *La Prensa* as his assistant clicked away with his Nikon.

"Perhaps Señorita Dr. Antis can say," I replied.

"It is ready to test now on a commercial farm," she said. "We are already preparing our holdings in Spain, near Trujillo."

La Prensa frowned. "Do we love Spain so much? Why not here?"

"And especially why Trujillo?" demanded the man from the Agricultural Ministry. "That's Pizarro's birthplace. May I remind you, Señorita Doctor, we removed his statue from the main square in Lima a few years ago."

Maria Antis smiled her secret smile. "Gentlemen, we have our reasons. Spain must be next. If we fail, isn't it

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better to fail over there, than here? Furthermore, in a historical sense, that remarkable rascal Pizarro is helping finance us. We owe it to his memory, and to his town, and to his mother country."

The reporter from *Time* broke in. "I understand Atahualpa Associates has bought the Pizarro Palacio on the plaza in Trujillo. Who is A.A. working for? The whole matter seems quite strange."

Maria ignored him. "No more questions, gentlemen? Then the conference is over." She and I walked back to the jeep.

"Don't look now," I whispered. "That fellow in the black wool business suit. He didn't ask any questions. He just listened, and looked. Especially at me. Who is he?"

She seemed suddenly very amused. "I insisted, and he very reluctantly gave me his card." She fished in her purse and brought out a stiff piece of white paper.

I read:

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Well, for goodness sake! Sweden! "What do they grow in Sweden? Corn? Barley? Why is he interested?"

She began to laugh, as though this was the funniest thing she had ever heard. I grew red in the face, but not from mirth. I grabbed her by the wrist.

"Jamie, Jamie! Stop, that hurts!"

I let go and waited.

She rubbed her wrist with her other hand. "Number fourteen, Sturegatan, is the address of the Nobel Foundation. I thought you knew."

"Oh." I took a long unsatisfying breath. "Well." What was there to say? So *they* were interested. It didn't mean a thing. They were always checking up on new scientific developments. They tried to keep all investigations secret, but she had blown the poor guy's cover.

"I'm sorry, Maria." I took her wrist and massaged it. "I was stupid."

"Yes, you were."

The Nobel in chemistry . . . impossible. I couldn't think straight. Momentarily I forgot all about Maria's nefarious mystery. If indeed there was one.

She pulled my sleeve. "If you can collect your wits, we'd better get started."

The overnight trip up into the peaks. She was going to show me where A.A. got its money. A gold mine, maybe? "Let's go," I said.

6. The Cave of Atahualpa

We reached the end of the road just as the sun was ready to drop behind the western peaks. At the terminus stood two crude stone cabins with thatched roofs. Two of Maria's mountain men stood in glum silence by the doorway of the far cabin. Four disdainful llamas were tethered to a nearby post. The jeep coughed to a halt. We got out and Maria exchanged a few words with her henchmen.

"We'll take the other cabin," she said cheerfully. "There's a cooking hearth, and they have already built a fire for us."

I could smell the smoke. Peculiar odor. What had they used for fuel? There was no wood up here. No trees. Nothing living, except occasional clumps of *quiche* grass. She anticipated my question and grinned. "Dried llama dung."

Marvelous.

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And now suddenly it was dark. No twilight. No dusk. Just as if somebody had turned off the lights. I brought our bags into the cabin while Maria made tea. Owing to the altitude the water boiled without become truly hot, and the consequent alleged tea was abominable. But at least it was wet and helped wash down the *pan de maíz*.

After supper Maria unzipped her canvas bag and pulled out a dark-hued stick. No (the dying flames from the hearth confused me), not a stick—a *bone*. I was never a medical student, but something told me it was a piece of a human thigh bone. There were small holes at one end and along the shaft. She leaned back against the cabin wall, put the instrument transversely to her lips (for indeed, it was a flute) and began to play.

That thing was like a magic wand. It wove a hypnotic net over me. I moved with it through these mystic mountains. I walked in the sierras, among stark shadows of desolate peaks. It was sublime; it was awesome. She showed me her world, her people. All this before Babylon was born, and before Egypt crawled out of the Nile mud.

Finally she stopped and tapped the flute pensively on her knee. "It is a simple native instrument, called a *quena*. The scale is pentatonic. This particular *quena* is very old."

In the semidark I looked at her, and I had questions I was afraid to voice.

She said, "A certain friar, Vincente De Valverde, accompanied Pizarro. He baptized Atahualpa, then made the signal to the garroter. Whereupon, for this and other good works among the Indians, he was elevated to bishop. As bishop, however, Valverde came to a serious end. He was captured by Indians on the island of Puná, and there he was killed and eaten. Very little of him was left." She ran off a scale on her flute.

The part of Valverde that was left. Was it . . .? I shivered.

She regarded me with mocking eyes as she replaced the instrument in her bag. "*¿Hace frío, Don Diego?*"

"*Hace frío.*" I unrolled my sleeping bag on the cold earthen floor. "*Buenas noches*, Maria."

"Well, James," said Maria next morning, "you are about to discover how we are financed. The answer lies up there, around the bend in the path."

At six thousand meters the Andean air blurred my vision. And I had been gasping and fighting nausea for the last several hours. (*She* wasn't even breathing hard, of course.) I said, "I see nothing. No path. No bend. *Nada*." Actually, I didn't really care how A.A. was financed. I went along because I liked Maria, and because I thought I might be of use to her on this weird Andean thrust. And especially because I was still trying to discover how her tangled skein of vengeance involved me personally. Early this morning, when the purple peaks were still indistinguishable from the night skies, the crew had turned the four waiting llamas over to us, and we had set out on foot. My heart had not been in it. For hours now we had walked (stumbled!) through colossal rocky detritus along an alleged path that only she and the animals could see.

So now she looked at me, threw back her head, and laughed merrily. The peals echoed and re-echoed among the

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multiple peaks. "Oh, James, if only your conquistador ancestors could see you now!"

I studied her gloomily. What did she expect? She was of the ancient mountain blood. Millenia of evolution had equipped her well for life on the sierra. But I was a mere lowlander. "Let's go," I groaned.

"*No está lejos*. Not far." She led the way through the boulders. "There." She pointed.

I shaded my eyes. A cave. The entrance was head high. Over the entrance was fixed some sort of utensil. A broom? Yes, a native broom. I had seen them before. And I knew the significance. The broom announced that the owner was away and would return. All who saw the broom would respect the announcement. The cave contents would be inviolate. The broom harkened back to a pre-Columbian Inca society, where thievery was practically unknown. (Thieves—as well as their wives and relatives —were caught, tortured, and killed.) And so the broom was still honored by the native dwellers of these parts.

She took some heavy canvas bags from the pack on the lead llama and we went inside. "There's an oil lamp over there," she said.

I found it and waited as she felt along a nearby table in the dim light. She struck a match, which sputtered uneasily in the rarefied air, and then she got the lamp going. As she lifted it overhead, its slow yellow flame was answered by sparkles and reflections out of the cave depths. The pupils of my eyes, already dilated by the dark, widened even further. I walked slowly behind her. Jewels . . . gold . . . silver . . . Fantastic treasures of a type heretofore seen only in museums in Lima, Quito, or Madrid. Emerald-crusted goblets . . . gold breastplates . . . ceremonial golden maces . . . golden earrings by the chestful . . . necklaces . . . amulets . . . bracelets . . .

"Take the lamp," said the girl matter-of-factly. "Hold it over here. I'll show you what to do."

I took the lamp. She pulled a golden vase from a stack at the side, laid it on a big flat rock in the cave center, and began to pound on it with another stone.

I leapt forward and grabbed her arm. "My God! What are you doing!"

"Don't be an ass, James. We have much to carry, and we must reduce the volume. Get a goblet or something over there and help me."

It was filtering in. She could not sell these things as such. Inca artifacts were by stringent law the property of the Republic of Peru. She was going to haul this stuff, at forty-five kilos per draft animal, down to a secret smelter. If detected, she could go to prison. I'd be in the next cell.

"We need another million dollars to continue the Project," she said quietly. "The plantings in Spain will take most of that, and of course we have continuing administrative expenses. Please help me now, Jamie."

I took a deep breath. I could deny her nothing. Besides, I knew now that I would take almost any risk to see the Project through to a finish. I wanted my place in history. And somewhere along the way I would solve Maria. She returned to her task, and I looked at her for a moment in the flickering light. Gold at fourteen or fifteen thousand dol-

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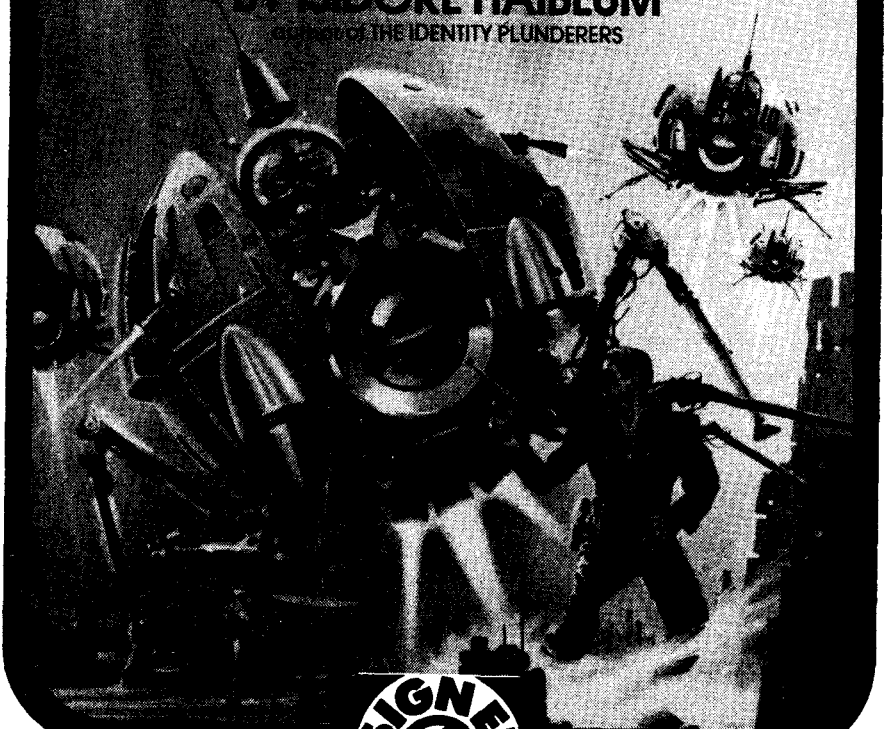
author of THE IDENTITY PLUNDERERS



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lars a kilo. The four animals would carry one hundred eighty kilos. Nearly three million dollars.

I was wasting valuable time. I put the lamp on what appeared to be a carefully bundled bale of goods, grabbed an ornate wine goblet, found a fist-size rock, and began to pound.

Between selections Maria explained in detail what I already knew in broad outline. In 1532, at the little village of Cajamarca, Francisco Pizarro and one hundred fifty soldiers had ambushed the Inca emperor, Atahualpa, and had held him hostage. "Where is the gold?" demanded the conquistador. "All over the empire," replied Atahualpa. Pizarro: "Tell your people to bring gold, all they have. Enough to fill this room to this mark." (That famous mark!) Atahualpa: "Promise to release me, and I will fill three rooms, one with gold, two with silver." Pizarro: "Yes! Yes! I promise." So treasure was collected at central points all over the Inca empire, and brought to Cajamarca, and the three rooms were filled to overflowing. "It is done," said Atahualpa. "Release me." "Kill him," said Pizarro. And so it was done. She finished quietly: "But not all the treasure had been brought in by the day of the murder. Here and there, in sacred caches known only to the Indians, precious things waited. And this cave was probably one of the richest."

And now I had to stop and think, because a very unsettling idea had occurred to me. I was not one of Maria's people. I even bore a conquistador surname. There must be tens—maybe hundreds—of millions of dollars worth of treasure in this awesome place. How could she afford to trust me? She didn't need me anymore. Not really. How could she be so sure I wouldn't return some day and steal all the treasure? Maybe she wasn't so sure. Maybe somewhere downtrail, an ambush of official Associates in those funny knit ear-flap caps was waiting for me with battle maces.

She watched my face. "Are you afraid?"

"Should I be?"

"The time for fear has not yet come," she said cryptically. "I can guarantee that you will make the return journey safely." She smiled faintly. "You can carry my revolver, if you would feel safer."

I thought a moment. The time for fear has not yet come, she had said. I wanted to ask her what she meant by that. But the question itself would reveal my concern. I shrugged, reached for a gold arm band, and smashed it flat with one blow. She responded with a derisive chuckle.

Within a couple of hours we had the animals loaded and (I thought) we were ready to start the long journey back. I was exhausted. I leaned against the entrance-way and tried to take slow deep breaths in the approved manner.

Maria watched me and frowned. "Sit down. I think you should rest a bit. Anyhow, there's one more thing . . ." She went back into the cave and soon returned with a strange rope-and-string affair. "This may interest you."

"What is it?"

"A *quipu*," she explained. "The Incas had no written language. They recorded everything on knotted colored strings attached to a base cord. Our cousins, the Tibetans, have similar string

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records. Colors and knot spacings meant different things: how many measures of maize and potatoes were harvested, how many stored, village populations; inventories of treasures; histories of the emperors, and so on. Each type of *quipu* had its own school to teach the meanings of the strings. The graduates were called *quipu-camayucs*, or 'rememberers.' This particular *quipu* is at once a recital of history and a prophecy of things to come. It gives our distant past, our present, and our future."

"Your future? Really, now." I may have sneered slightly. "Of course the *camayucs* who can read it are long dead."

She didn't seem offended. "Except the last."

"You?"

"Yes. I can read it."

I smiled. "And what does it say?"

"It was assembled in the middle of the sixteenth century, and it starts with the omens and oracles presaging the death of Atahualpa and the impending destruction of the empire. That portion is history, because it was written here after Atahualpa's death. Are you interested in the details?"

"Sure." I love fairy tales.

She fingered the strings at one end of the rope. "In your year 1527, five years before Pizarro's invasion, sorcerers reported terrible omens, all recorded here. Three large haloes circled the moon. Lightning struck the emperor's palace in Cuzco. We had several bad earthquakes that wiped out entire villages. Down at the shore the tides were much higher than usual. A sick eagle fell from the sky. At night a green comet appeared in the heavens. And so to August 19, 1533, and the murder of Atahualpa."

All that was five hundred years ago. Water long under the bridge. What difference did it make now? "Go on," I said.

"Next we pass through the bloody events of the Conquest, with marches and countermarches, revolutions, mutinies, and Pizarro's assassination. Then the colonial consolidations, opening the big silver and tin mines in Bolivia, reign by the Spanish viceroys. The long genocide. The peasant population drops from fifteen million to less than two million. Next, the early nineteenth century, and the revolt against Spain. By now two hundred billion dollars in minerals have been stripped from Bolivia alone. In the twentieth century we try to recover. And now we approach the end." Her dark eyes glistened as her fingers moved along the mysterious knotted cords. "The end begins next year, in December."

"What happens?"

"A very great event, which simultaneously signals catastrophe for the children of Pizarro, and the migration of the mountain people down to the lowlands."

"And what is this event?"

"A fantastic storm. The earth has never before seen such a storm."

I did not know what to say. None of it made any sense. I shook my head. "How can this be?"

"It is truly prophesied," she said. "There is no question. Our seers are long dead, but when they lived and functioned in the Inca temples, they were always right. Long before the Spaniards came, they predicted that

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bearded white men would come from the sea and destroy us. And five hundred years ago they predicted this coming storm, and the Great Change, and that the mountain people would come down and take over the earth. And not just in the Andes will this happen. Folk of the high mountains all over the world will start coming down into the valleys and the lowlands. The Sherpas, our cousins, will migrate down from the Himalayas. The Tibetans will move down into the Chinese lowlands."

She was crazy.

"Hm," I said. "Very interesting future."

"That's just the start. Within a very few years those of us who are left will note that it is becoming colder. Ice caps will form once again over Canada and North Europe."

She seemed so certain. Maybe *I* was the crazy one. I said, "Is that what you read in the *quipu*?"

"Yes. It's all there."

"Could I see that thing?"

She handed it over.

I fingered it casually. Just a bunch of colored, knotted strings woven at varying intervals into a piece of rope about three feet long. I held the rope by the two ends and let the strings dangle in the stark sunlight. I understood none of it. I don't know what I expected. "The strings seem to be different from the rope," I observed.

"Yes. The strings are braided from llama wool, the rope is woven from *quiche* grass. Pizarro used the rope to garrot Atahualpa; afterward he gave it to our priests." She said this matter-of-factly, as though reciting a paragraph of dry and ancient history in a schoolroom.

My hands trembled as I returned the *quipu*. "Maria," I said carefully, "you mentioned back in Washington that you named your bacillus 'Fifteen Thirty-three' to mark the year Pizarro murdered Atahualpa."

"That is so."

"Obviously, the name of the Project, '*Respuesta a Cajamarca*,' signifies some sort of attempt to avenge the murder?"

"*Verdad*."

(And now we come to the crunch.) "You plan, in some way, that Fifteen Thirty-three will destroy the civilization of the lowlands, and that the mountain people will inherit what's left." With my eyes I accused her.

"Very perceptive of you, James."

Total insanity. Or was it? Was there something in Fifteen Thirty-three I had overlooked? Suppose it went wild? Explosive mitosis . . . Suppose it drank up a lot of nitrogen in a hurry. What would *that* do? Lots more cheap fertilizer, that's what. At least according to the Lab Administrator.

I relaxed. I looked her in the eye. Very firmly I said, "Maria, listen to me. Fifteen Thirty-three will *not* reduce terrestrial air pressure to one-half atmosphere. Fifteen Thirty-three is *not* a Reply to Cajamarca. It just won't work. Forget your revenge. Anyhow, all that was five centuries ago."

"We remember."

It was useless. She was a monomaniac.

One more suspicion. "This Atahualpa fellow. What finally happened to him?"

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"Pizarro buried him with full honors."

"And then?"

"Our priests dug him up again. They mummified him in the correct way, as befits an Inca emperor, and they hid him in a safe place. All this was long ago."

"They hid him in this cave. Right?"

"Yes, here in the Cave of Atahualpa. You saw him. You placed the lamp on his head."

"*Madre de dios!*"

7. Trujillo

I had hardly returned to Washington when I got a call from the Peruvian Embassy. There had been a most peculiar atmospheric disturbance in the area of the experimental hectare. I thought immediately of Maria's prophecy. "A *big* storm?" I asked uneasily.

"Oh, no, nothing significant." He called it a *torbellino de polvo*—a dust-devil. Some of the soil had been blown east, up into the eastern mountain ranges. I was still uneasy. I didn't know what to make of it.

I called Maria right away. "We know all about that." (She actually sounded happy.) "Just a little local whirlwind. No, not the prophesied storm. We get them in the mountains from time to time. Relax, James! We're starting the Trujillo plantings. Meet me in Madrid, I'll drive you out."

The Trijillo plantings . . . Another *non-sequitur* piece of the puzzle. Why would she plant this immense acreage near the birthplace of the man she hated above all others? Was now the time to demand an explanation? And if I asked, would she answer? Perhaps. Could I figure it all out for myself? Perhaps. Meanwhile, I'd play along.

Ten days later we were in Spain. I decided to ask some questions.

"Why here?" I asked. "Why this town, why this building?"

"Have you no sense of irony, Dr. Ruiz? Our great ancestral enemy was born here in this little town of Trujillo. There's his statue in the square. How proudly he bestrides his horse! How bravely his bronze plumes fly! His brother Hernando, one of the devil-band, inherited the wealth and the title, and built this fine palacio, facing the square and the church. Since it was built with money stolen from the Peru, it was quite logical that we re-acquire it. How do you like it?"

Even in the hot Spanish summer the big building seemed cold and forbidding. "Very impressive," I said.

"Isn't it? We sit drinking our tea in the statuary room. Over there the two spade-bearded brothers look down on us. Mean-looking, wouldn't you say?"

"Very."

"And outside you saw Francisco's coat-of-arms, carved in stone. Shows Atahualpa and the other Inca chieftains bound in chains. How did you like it?"

"That's enough, Maria." It was hopeless. She simply turned questions into accusations. I could get nothing from her.

"To business, then." Her lips curled in enigmatic victory. "Shall we drive out to the fields? We have four thousand hectares ready to inoculate. And the maize seed is ready to plant."

"That's more like it. Let's go."

And so into the jeep and northward up the village road, which wound through

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a scraggly growth of grass and shrubs, broad expanses of heath, and fragrant islands of lavender. Occasionally we passed flocks of sheep, grazing between intermittent olive groves and cork trees. The vistas were serene and charming. I felt a vague regret about revolutionizing it with modern agriculture.

Within the hour Maria stopped the jeep along a stretch of fence interrupted by a wooden gatehouse. The gate keeper bowed to her and pulled up the entrance bars.

"That cap," I muttered, "isn't that another *chullo*?"

"Yes. The Associates sent him with me. Pyxu is a purebred Andean. We'll stop here near the gate for a moment."

"What for?"

"A ceremony," she said. "Back home, when a new field is opened, there is a ceremony. Ah, look. He has already dug the hole. Here, take this." She handed me a small wooden box, sealed with iron straps. Weight, perhaps twenty pounds. The wood had a fragrant medicinal scent.

"Lower it into the hole, gently," she instructed.

I did. "What's in the box?"

"A llama embryo." She began chanting quietly. "*Chaupi punchapi tutayaca . . .*"

I waited for her to finish. "And what was all *that*?"

"A *quechua* lament. 'Night has fallen at noon.' So mourned the followers of Atahualpa when Pizarro killed him."

I knew I should not have asked.

And so back to the car. We spent the next hour driving through the paths in the fields. When the inspection was complete, we drove back to the gatehouse, thence to the highway, and on east for several hours on highway NV to Barajas airport outside Madrid. By then it was dark. When I got out of the car she handed me a little artifact, a small hemisphere about half the size of my fist, flat on the bottom, and covered with a clear acrylic dome. Inside, the bottom appeared to be covered with a centimeter of plain dirt. I turned it this way and that, and finally upside-down. The soil followed the movement. I read the legend on the bottom: *Buena suerte*. "What is it?" I asked.

"As you see, a good-luck piece. The soil is from the Trujillo hacienda inoculated with Thirty-three. Keep it as a souvenir of a great success."

"You hope." I put the thing in my jacket pocket, hefted my bag, and trudged into the terminal.

8. The Award

The Trujillo fields were indeed a tremendous success. And this success had a certain consequence, not entirely unexpected.

In November I got a cablegram at my home in Virginia:

FOR YOUR RESEARCH IN GENETIC ENGINEERING AND YOUR DEVELOPMENT OF FIFTEEN THIRTY-THREE THE NOBEL FOUNDATION OF STOCKHOLM ON BEHALF OF THE ROYAL SWEDISH ACADEMY OF SCIENCE IS PLEASED TO INFORM YOU THAT YOU HAVE TODAY BEEN VOTED THIS YEAR'S NOBEL PRIZE IN CHEMISTRY. THE PRIZE WILL BE A GOLD MEDALLION AND A CHEQUE FOR TWO HUNDRED AND TWENTY THOUSAND DOLLARS. THE AWARD CEREMONY WILL TAKE PLACE IN STOCKHOLM ON DE-

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CEMBER TENTH. DETAILS FOLLOW. HEARTIEST CONGRATULATIONS.

I was elated; but I trembled. Something was wrong. I called Maria in Trujillo. "Congratulations!" she cried. "You certainly deserved it." But now she seemed to hesitate. I could guess what she was thinking.

"You think it's premature," I said defensively.

"I didn't say that."

"Actually," I explained calmly, "Nobel's will provides that the awards be given for work in the previous year."

"A provision largely ignored."

"Not always. The Curies isolated radium in 1902 and got the award in 1903. Moisson published his work on fluorine in 1906 and got the award in 1907. The first human was injected with insulin in 1922, and Banting picked up the prize in '23. Urey published heavy water in '32 and received the award in '33." I sniffed. "There's plenty of precedent."

She said slyly, "But don't they favor older men?"

I bit. "Bragg was twenty-five when he got it for x-ray crystallography. Anderson, Heisenberg, Lee, Dirac . . . they were all thirty-one."

She burst out into peals of senseless laughter. "Oh Jamie, Jamie! You looked it all up! You've had the Nobel fever for *months!* I'll bet you even calculated your odds on the Hewlett-Packard! Jamie, you shameless *conquistador*!"

I shouted into the phone. "Now cut that out!" I may have said a few other things, too. Finally we both calmed down. "Will you be there?" I said. "It's your project, too, you know. Please, Maria?"

"I will see you in Stockholm." She was suddenly very serious. "Count on it."

After I put the phone back, I sat there thinking. Premature? Not the Nobel aspect. Yet, in another sense, it was premature. For I still hadn't solved the puzzle of Maria. I needed more time. She still thought Fifteen Thirty-three was going to absorb half the nitrogen in the atmosphere, thereby reducing air pressure at sea level to one-half, thereby destroying civilization in a great storm, thereby leaving a world only the mountain people could cherish. No, Maria. No. Fifteen Thirty-three won't do it. Sure, it'll take up the N_2, but no storms, no catastrophes. We shall fertilize in stately good order, Maria. We are happy to take your money, but we can't sell you any apocalypses.

I called the Administrator. He was ecstatic. "You won't need a raise for a couple of years. And with all the new clients, we can expand the west wing." Otherwise it was all quiet at the lab. He set up a press conference for the next morning. A command performance.

I was astonished at the turnout. The reporters asked whether I was married and what I had had for breakfast. Then they took my picture and the Administrator mercifully took over and explained our place in fertilizer history.

"It's the first large-scale organic nitrogen fertilizer that works on all crops. Also it's immediately available at the beginning of the crop season, and no source crop has to be plowed under. In fact, there is no source crop."

"You said *organic* nitrogen?" said one of the reporters. "You mean all the

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other commercial fertilizers have been artificial? Made in a chemical plant?''

''Nearly so—at least since World War I. Historically, all packageable nitrogen fertilizers have been synthetic and have required big commercial plants and a great deal of capital investment. One of the first was Caro-Frank cyanamide process.'' He wrote quickly on the blackboard: $CaC_2 + N_2 \longrightarrow CaCN_2 + C$. ''Then the Haber process. $N_2 + 3H_2 \longrightarrow 2NH_3$. And the arc process: $N_2 + 2.5\ 0_2 \longrightarrow N_20_5$. All required big plants and millions of dollars. In contrast, the farmer can ferment his own Thirty-three in barrels in his barn. He can spread it in equipment he already owns, all at an amortized cost of about fifteen cents an acre. Once spread, it's there forever.''

''Won't anything kill it?''

''Well, of course practically all bacilli are susceptible to the standard sterilizants: heat, alcohol, phenols, and so on. Also, Thirty-three requires oxygen. If the oxygen concentration in the atmosphere falls to a certain level, Thirty-three goes dormant. But we don't expect any of these factors to be a problem for the world-wide dissemination of Thirty-three.''

10. December

On the evening of December tenth, members of the Nobel staff led us by the hand into the Stockholm Philharmonic Concert Hall. (They had coached us thoroughly, and had put us through a dry run the day before.) It was a majestic occasion. I came full-panoplied: white tie, tails, black pumps. They sat us on the orchestral stage. While the Master of Ceremonies gave his brief recital in Swedish, I was searching the high loges for Maria. I hadn't seen her yet. Maria, where are you? But the light was flowing the wrong way. I couldn't see anything. Had she made it into town?

Now here comes the M.C. He signals to me. ''James Ruiz!'' My big moment. I jump up. Somebody steadies my chair behind me. I barely succeed in controlling a grin. Damn, I am happy! He guides me down the string of carpet along the railing and we reach the stairs. He stops there, and I proceed down the steps and along the carpet to the king. I shake hands with Gustaf VIII. I am dizzy, but I hear certain words, in English. (His English is better than mine.) ''James, I congratulate you for your research in genetic engineering, which has led to Thirty-three and the promise of bounty for millions of our poor and hungry.'' He hands me a beautiful leather box. ''Your certificate and medallion . . . You can pick up the check in the morning.'' I mumble something. Thank God he is used to mumblers. He just smiles. I step back. The trick is to get back up the stairs and to my chair without turning my back on him. I do this without a hitch. And now everybody out there rises and applauds. This is my moment. I will never forget this as long as I live. When things finally quiet down I open the box lid and peek at the roll of parchment.

KONGLIGA SVENSKA
VETENSKAPS-AKADEMIEN

That means Royal Swedish Science Academy. Next, something about Alfred Nobel. Then my name at the bottom.

I look up. Maria, are you out there? Is all this written on the *quipu* of Ata-

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hualpa? And speaking of prophecies, here it is December. Where's that big storm?

It is the next day. Still no contact with Maria. Well, she knew where I was staying, a suite in the Grand Hotel, a guest of the king of Sweden. She could at least leave word.

Just now I'm wandering in Berzelius Park, and despite the cold I sit down on the bench in front of the statue of the great Swedish chemist. "J.J.," I mused, "what would *you* think of Thirty-three? For that matter, what would you think of *nitrogen*, and all the uses we have found for it in the last two hundred years? You're certainly entitled to an opinion. It was your idea to use the initials of the element names in writing chemical formulas. N for nitrogen, you said. Simple, once you accept it.

Funny name, nitrogen.

Maria calls it *nitrógeno*. The French call it *azote*, meaning lifeless. To the Germans it's *Stickstoff*, foul air. With a capital S. It's four-fifths of our atmosphere and an essential constituent of our genes. It enters our bodies as plant and animal protein.

But *lifeless? Au contraire!* It is the very stuff of life. Before algae, chlorophyll, and photosynthesis began to pour out free oxygen into the pre-Cambrian atmosphere, all life was anerobic and fed on nitrogren.

And yet (did you know, Herr Doktor), that nitrogren is one of our scarcer elements? You look up in the sky, and you think, "Gracious! Four point five metric tons of nitrogen on each and every square meter of the planetary surface! That's a lot of nitrogen!" Not really, J.J. Because that's about *all* there is: only three hundredths of a percent of the crust. We have twice as much sulfur, three times as much manganese, twenty times as much titanium, and sixteen hundred times as much oxygen. So let us deal carefully with our precious nitrogen, eh Jöns Jacob Berzelius?

Where did it come from, in the beginning? From primordial hydrogen, in easy stages, the astrophysicists say. You can do it all in the core of a red giant star. All you need is fifteen million degrees Kelvin. The hydrogen fuses to helium. Then three heliums fuse to one carbon in the triple alpha process. Then the carbon picks up a couple of hydrogens, and presto! Nitrogen! Of course, it's stuck there in the star, and of no use to you and me until the star novas. After that the nitrogren is blown out into space, and before you know it, it's sucked up by some nearby proto-solar system, and will soon be part of a planetary atmosphere.

I rose and stretched. Nice talking to you, J.J. But now I have to go shave and shower. The king has invited us Nobelmen to a big banquet in the palace this evening. Can't disappoint him, can I?

(Maria, where in the dickens are you? They're saving a place for you at the king's table. Maybe you don't want to show up because you know you've lost. Maybe you've finally faced up to it. No revenge. Your Fifteen Thirty-three isn't going to turn the world back to your mountain people. No drop in worldwide air pressure. Sorry, Maria. Fifteen Thirty-three will work as scheduled. You're going to enter history, not as a demonaic destroyer, but as a mythical

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benefactress, like Ceres . . . Gaia . . . Demeter.)

11. Buena Suerte

I had just come out of the shower and was pulling on my bathrobe when I was distracted by a faint hissing sound, rather like an ancient steam radiator, or a teakettle that had lost its whistle but was still trying. It took me a moment to realize that it was coming from the top of my dresser.

The little hemisphere—Maria's good-luck piece?

I hurried across the room and picked up the artifact with both hands. Yes, definitely, here was the culprit. Air was leaking *in* to the little dome! How could that be? But there it was. I could even see soil particles being blown around by the imploding air leak. Something, somehow, had created a sudden partial vacuum within the little dome, and ambient air was rushing in to fill the void.

The ominous whisper died away, as though to announce that Buena Suerte had quieted down and was once more at peace with the world.

I replaced the souvenir on the bureau and stood there, thinking, and breathing irregularly. Perhaps the air in the little chamber had cooled off, the volume had diminished, and ambient air had moved in to replace it. No. Ridiculous. But certainly the gas volume had shrunk. On that point I was fairly sure. Of course, Thirty-three was supposed to absorb and fix nitrogen out of the air, but it had done that weeks ago, and the amount was negligible in any case. Unless . . .

My hands trembled as I picked up the model again. Yes, there it was: a scintillating iridescent orange microbial lawn. Thirty-three had grown like a miniature forest fire out of control. And had gulped down *all* the nitrogen in the air in the little chamber.

Explanation? Perhaps this was the result of one never-again accidental cosmic radiation shower, which had altered the gene structure of one—just one—Thirty-three cell, and that one cell had multiplied and proliferated and had taken all the nitrogen and some of the oxygen, and had caused the partial vacuum.

That had to be it. A sport. An accident. It had happened this once and would never happen again. It's *not* an inherited characteristic, I told myself. Not something they were all born with. Not something lying there latent in all their stringy little bodies, awaiting to be awakened by time, warmth, sunshine. Not something already tucked away in that first culture of Fifteen Thirty-three that Maria gave the Administrator that day in Virginia, months, long months ago. No, it couldn't be. Because if it were, the bugs would be awakening in four thousand hectares near Trujillo, Spain. Nitrogen would be disappearing over all those acres. It would go suddenly, drunk up as by some strange sponge. In the Estramadura of the *conquistadores*, nitrogen would vanish, the air pressure would drop to one-half of an atmosphere, creating a low pressure system never before encountered on the planet earth. And then the air would rush in. It would arrive as a giant tornado. The funnel would be miles across. Actually, there would be no word for the kind of storm that must come. By whatever name, it would lift Thirty-three-impregnated soil high into the air

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and over the next days and months and years the little horrors would move eastward, gobbling nitrogen as they multiplied. They would keep at it until the oxygen fell below a viable concentration for them, and then they would go dormant. Finally the air pressure over the entire world would register one-half atmosphere. In the lowlands men, women, children would gasp and get sick and finally most of them would die.

No! No! No!

It was inconceivable.

Therefore it couldn't be.

What kind of logic was that?

I thought back to the Peruvian planting. Only one hectare. Yet they had had a micro-storm. A dust-devil, they had called it. Nothing to worry about.

The *quipu* had prophesied a great storm in December.

She had known. She had known from the beginning.

I replaced the little hemisphere and picked up the phone. "Hallå?" (How did it go in Swedish? My hands were shaking and I couldn't think straight.) "*Jag vill ringa det här numret* . . . in Trujillo . . . Spain." My pronunciation was awful.

The operator seemed to hesitate. "*Tala Ni engelska?* Do you speak English?"

"Ja! I mean, yes."

She came back in English. "What number in Trujillo, please?"

I gave the number of the palacio.

"One moment please. *Ett ögonblick.* Trying. Still trying. One moment. Ah, sir, we have a report that there is a temporary condition—"

I tried to think. "Try Guadalupe, the Guardia Civil . . . it's about forty kilometers due east of Trujillo."

"Yes. One moment. No. No connection. Shall I try—"

"Madrid," I croaked.

"No need." It was Maria. The door closed behind her with a somber click. "All lines are out." She lifted her chin high. "It is the beginning of the end, James. The storm has been going on for several hours. The media have gone in with cameras, and I think by now they can show us something on TV."

I put the phone back in its cradle. Silently I walked over to the TV and turned it on. We watched the screen come alive.

What we saw was not easy to define: just racing roaring gray dust. I could make out no physical features. Then the scene shifted. Below us a city was spread out.

"Madrid," said Maria quietly. "The larger soil particles are already settling out. They are carried eastward by the prevailing westerlies. By this evening, when you are making your acceptance speech in the Royal Banquet Hall, peasants in the Pyrenees will be wrapping mufflers about their faces and running for their houses."

The scene changed again. This time a strained disembodied voice explained that we looked down from a satellite eighteen thousand miles high. It was five P.M., and the afternoon sun showed an immense cancerous thing, which streaked as a broad ellipse from the Portuguese border eastward beyond Madrid and Toledo and into the Province of Guadalajara. It was no longer one storm. As if answering a genetic command to imitate its microorganic masters, it was

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slowly dividing and subdividing. This colossal horrifying mitosis was quite visible on the glass TV panel. All these daughter storms were moving counterclockwise in deadly pirouette, obedient to the Coriolis effect of the turning earth.

Maria offered her own commentary. "Suspended dust will screen out the sun for fifteen or twenty years. Snows that fall in winter will not melt in summer. A new ice age must come. Once more we will hunt thick-furred creatures at glacier faces: the caribou, ibex, chamois. Horses and cattle will go wild, and we'll hunt them as we did twenty thousand years ago. The Siberian-Alaskan land bridge will form again, and the snow tigers will cross over. Perhaps in future millenia extinct ice-age creatures will return: the wooly mammoth, the giant aurochs, the dire wolf. Only the simple mountain people can survive in such a strange world."

Together we watched the monster devour Spain. She was ecstatic; I was horrified. The tentacles of the thing reached now to Pamplona, where long ago Ernest Hemingway had watched the running of the bulls. Next on the menu, the magnificent seaport, Barcelona founded (they say) by the great Carthaginian Hamilcar Barca. Then Roncevalles, where the mountain men ambushed Charlemagne's rear guard and slew them to the last man. I knew exactly how Roland felt when he blew that last despairing trumpet call.

"You knew all along," I said heavily. "You knew Thirty-three had a latent explosive mitotic gene. You knew it would lie dormant for a certain period, then start multiplying at a fantastic rate."

"We knew. At least, we hoped."

"But why involve my lab? You had all the genetic engineering you needed, right in your own group."

"No. We tried. Our bacillus had a fine latent multiplier gene, but the cell was a poor nitrogen fixer. We needed to expand the nitrogen intake. We needed genetics we couldn't handle in our own shop. Atahualpa Associates had to have a bacillus that would lie dormant, fix nitrogen at an unprecedented rate, and then abruptly and without warning, it had to spread out through the innoculation area and pull in practically all the overhead nitrogen. To create this bug, we needed a top-drawer genetics engineer. We needed *you*."

"And I delivered." I smiled grimly. "Ironic, isn't it? Long ago, my ancestor Bartolomé Ruiz, the great navigator, led the lowlanders to your people. Now his fifteen-generation descendant leads your people down to the lowlands."

She shrugged. "It is, how you say, funny?"

But I wasn't laughing. "And all this soil that's moving eastward, it'll infect the land wherever it comes down?"

"Infect? Inoculate is a nicer word."

"How long is the incubation period?"

"About one year."

"Then storms again? And again? And again?"

"Of course. Until ambient sea level air pressure drops to one-half atmosphere. Then the bacilli go dormant. They have done their work."

"You planned it that way?"

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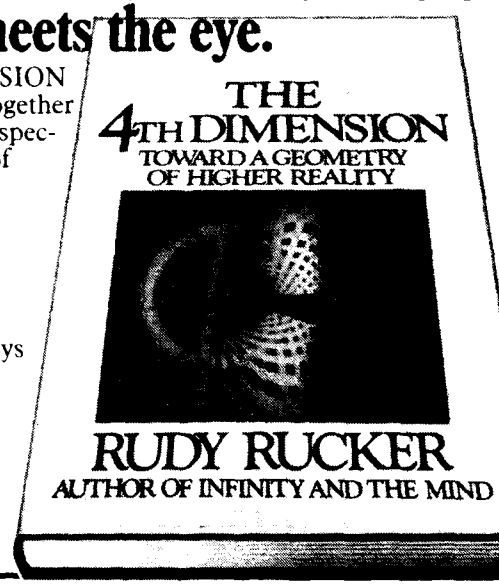

"Not just I, James. I am but one of a group."

"Atahualpa Associates requires that billions die?"

"True, James. But they are all lowlanders. They will not be missed."

"I'm a lowlander."

"You will survive. In any case, I refuse to let you put this on a personal basis." She frowned and crossed her arms on her chest. "James dear, please think back. Directly or indirectly the Spaniards killed nearly all our people. And now it is their turn. Be fair."

I felt a sense of suffocation. I felt like Atahualpa when the garrot began to tighten. "Maria, the men who did this to your people have been dead for five hundred years. There are no longer any *conquistadores* alive. You are killing only the innocent. You are killing men, women, and children who never even heard of Pizarro."

"Ah, so eloquent, dear James. You hold up a mirror to history. Five hundred years ago the Spaniards performed exactly as you now complain. They too killed men, women, and children who had never heard of Pizarro. And consider, *amigo*, who owns the Peru today? Who owns the fields, the mines, the factories, the media? Who? The forty families, that's who, the descendants of that infamous satan-band. The children of the fathers still drink our blood. They pat their swollen bellies. They smile as they watch my people try to ignore their hunger by chewing coca leaves."

"I think you rather overstate the case," I mumbled.

She ignored me and continued. "You must look at the bright side, James."

"The bright side?"

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"Of course. Thirty-three is not nearly as catastrophic as a general nuclear war. *That* would kill *all* human beings within a few months, or so they say. Our way, at least *some* human beings are left."

So that was the bright side. I stared at her in mingled stupefaction and wonder. "You seem so calm. You feel no guilt. You feel nothing."

She hesitated. "You're wrong, James. I do feel guilt, toward the innocents who are going to die; and especially, I feel guilt toward you, for I have betrayed your trust. But I had to do as I have done. History required it. I leave you now." She opened her purse and took something out. A disc . . . it glinted. On a sparkling chain.

Had I seen it before? Yes, I thought so. Back in her little lab in Lima.

"It is a *canipu*," she explained. "In ancient times the emperor gave it to a noble for distinguished service. It is also the key to the storage room of our Lima lab. Remember the oxygen cylinders? We put them there exclusively for you. Return to Lima, James, and live!" She laid it on the vestibule table. "*Hasta la vista.*" The door closed behind her.

Let her go. It was just as well. I didn't want her around when I made the next call.

Back to the phone. "Operator, I want to call a number in Manassas, Virginia, U.S.A." I soon had the Administrator on the line. To incredulous ears I explained what had happened in Spain, and what would soon be happening across France, and then Germany, and finally in the rest of the world. "We can deal with it," I insisted. "You'll have to contact the agricultural attaché at the Spanish Embassy." I outlined all the steps.

"But the money," he groaned. "You're talking a couple of million. Where do we get that kind of money?"

"I haven't the faintest idea," I said.

When we were through, the Administrator had a sudden afterthought. "I saw you accept the Prize on TV yesterday."

"Yeah." I was noncommittal.

"And you've got to make a speech tonight?"

"As soon as I get out of here."

"What are you going to say?"

"Good question. I'm curious myself. I'll be on TV. Tune in, in case I have some afterthoughts." I hung up.

12. De-nitro

We are in the Golden Room, in the Royal Palace. It has been a wonderful meal. I just wish I had been able to enjoy it. There is a long table along one side of the room. Here sit King Gustaf and the royal family, the Nobel Committee, and the prize winners and their families. The other guests, about four hundred, sit at long tables spaced edgewise to ours. There have been speeches. And now it is my turn. I'm not a good speaker, and I'm scared. But I have to do it.

Up, James. You won't need notes for this one.

"Your majesty, members of the Committee, ladies and gentlemen. I have something very important to say; yet, I will be brief. Two hours ago an extraordinary event occurred that conclusively indicated—nay, *proved*—that the Thirty-three-inoculated plot at Trujillo, Spain, was a disastrous failure. In

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"It is mind-boggling!"

"I'm excited about GODS OF THE GREATAWAY," continues Don C. Thompson in *The Denver Post*. And no wonder. The triad from *The Celestial Steam Locomotive* is back in Volume II of "The Song of the Earth Trilogy," determined to battle the dreaded Bale Wolves for the release of Starquin and control of the Galaxy and Dream Earth.

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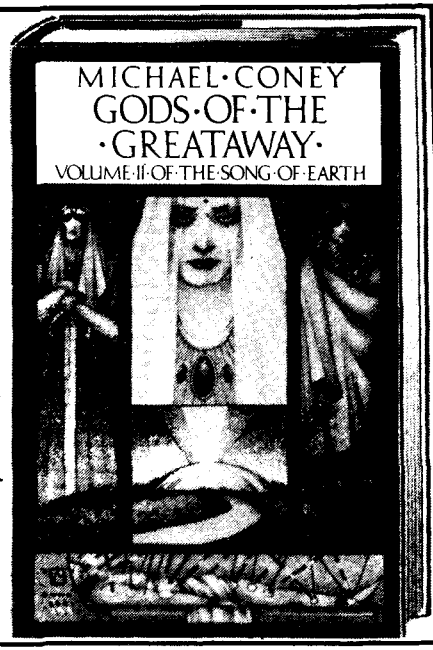

short, the Thirty-three bacilli absorbed all the overhead nitrogen and much of the oxygen, causing a gigantic storm. The fields have been stripped of surface soil, which is blowing away to the east as great clouds of dust. Wherever the soil redeposits, it will infect that land. Unless the infection is treated, it will spread all over the world. Much atmospheric oxygen and nitrogen would be drawn into the soil. The air pressure would drop severely. A great many people would die."

I looked out over the shocked, uncomprehending faces. Very few understood what I was talking about. Did the Nobel Committee? Did the king? Hard to say. No matter. I had to go on, get to the end.

"Fortunately, a remedy is available. It is a denitrifying bacillus, called De-nitro, actually a close cousin of Thirty-three. It releases enzymes that break out the nitrogen in Thirty-three and return it to the atmosphere. It does this very rapidly, and it spreads just as fast as Thirty-three. I have already made arrangements with our Laboratory in the States to start the crash production of De-nitro. We expect to begin spraying the affected areas in Europe within sixty days, and we expect that all danger will be over within the year. Whether Thirty-three will ever be useful as a cost-free nitrogen fertilizer awaits the results of much supplemental research. I am sorry . . ." I turned to the king. "Your majesty, gentlemen of the Committee, I will of course return the diploma, the medal, and the check. But the memory of your warmth and hospitality will stay with me always. And now I request permission to withdraw."

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The king rose, nodded, and said something I didn't catch. Then he smiled and began to clap his hands. He was applauding me! What for? No good reason that I could see. And now the entire audience, row by row, rose at the tables and joined in.

Oh God, I thought. I backed away, trying to continue to face the king, trying to remember the protocol. And so to the door, where I found one of the royal equerries awaiting me. Red sash and epaulettes. I was being kicked out in style. "His majesty got word that you might do this," said the officer. "He was also told that your life may be in danger. A helicopter waits in the square. We're to take you to Märsta, direct to the airport. Save an hour."

I didn't get it. The king knew? Who had been talking to him? "I'm on the eight P.M. SAS to Heathrow," I said.

"His majesty suggests that you take an earlier flight, the Concorde to Washington."

A direct flight! "Can we make it?"

"They are holding it for you."

The king had influence. "Wait a minute —my bags."

"Already in the chopper, Dr. Ruiz."

And there it was. A Bell JetRanger. Its white flank carried the crossed bars of the Swedish flag and the two lions rampant of the royal court of arms. This was the king's personal whirly.

Head low, I held on to my hat and hustled up into the bird. The equerry waved goodbye, and I moved cautiously into the cramped rear. One of the two black seats was already taken. I gasped. "Maria!"

She looked up nervously and huddled into her seat. "I was registered as your secretary, you know. They assumed I was to return with you."

I stood there, not moving, and wondering how best to get her thrown out—preferably after we were a couple of thousand feet up.

She said, "They bugged your room phone, James. They know about Denitro. I'm sure it will work, especially if you handle the program."

" *'They'?*"

"The Associates. They wanted me to kill you. I couldn't."

She could kill billions, but not me. Why so squeamish? And now it was *they*, and not *we*. What was going on?

She continued with a small diffident voice. "I'm going back with you, James. Also, I heard your speech on my portable radio, renouncing the award. I was so proud of you."

I thought, don't try to sweet-talk me, babe. It's a bit late for that. I took a tentative step toward the empty seat. "Why are you here?" I said tersely. The cabin door slammed shut behind me. The chopper lurched, and I fell forward and into the seat beside her.

The Allison 250 turbine geared into the rotor, and it began to roar. She leaned over and spoke into my ear. "Cajamarca is dead—killed by De-nitro. That was bad enough. On top of that I refused to kill you. So now we're both on their kill list. For the time being, though, we're fairly safe. I explained the situation to the palace security people. This helicopter is the king's idea."

She had been active. Whether I liked it or not, our lives were still intertwined. We were united by mutual catastrophe. Our failures had been forged in the same furnace. But I still did not forgive her.

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Not completely. Maybe a little, though. However, there were still some loose ends. "The king applauded my speech. Why?"

"Because he and the Committee already had some preliminary reports about the storm. And because you were the first Prize-winner in history to turn his acceptance speech into a renunciation. And also because I told Gustaf you were a man of large integrity."

So *she* was responsible. And it all made sense. Maybe I should ease up a little. "About the Project," I said, "you certainly deserve an E for effort."

"I know," she said sadly. "I tried. The failure wasn't really my fault. We just didn't appreciate De-nitro."

She didn't regret the Project, only that it had failed. Maria, we leave you to heaven; you are beyond the judgment of human beings.

"You hid De-nitro very well," she said. It wasn't an accusation; just a simple statement.

It was my turn. "The best way to hide something is to put it in a government publication. Better luck next time."

"No, no next time. That's the end of it. But wait . . ." She brightened. "You'll need a big spray-plane program if your De-nitro is to be truly effective."

"That makes you happy?" I said sourly.

"You'll need a lot of money."

"A lot," I agreed.

"Then you forgive me? Completely?"

She was incredible. I now knew exactly what she was driving at. "Not so fast. How much is left in the cave?"

"About twenty million. Not counting the mummy."

"I thought you couldn't go back. You said—"

"*You* could go, dear James."

I thought about that. "Even if I could get by your friendly assassins, I could never find the cave."

"Nonsense. You could find it. After all, you are a direct descendant of the great Bartolomé. *He* could find anything."

I just shook my head. Still, twenty million. No, that's what it's worth if it's melted down into bullion. As priceless pre-Columbian artifacts they could add up to half a billion. To hell with a llama pack train. Get up there with a chopper. Bypass the Associates. Bring it all out in a couple of days. But if I mess up, I'm in real trouble. To do it right, I've got to have Maria. As she damn well knows. Also, hadn't she mentioned other caves, other caches? Did she have maps? First, of course, we had to save the planet. But afterward . . . Perhaps at heart I was just a simple conquistador, trying to get ahead in a difficult bloodthirsty world.

She was watching my face from the corner of her eye. She sighed. "You know so little of your history, or ours. Do you know what happened to Atahualpa's sisters and daughters and nieces and graddaughters?"

"Can't say that I do."

"They all married *conquistadores*. That way they kept the wealth in the family. Did I say *all* married? There was of course Inés-Andrea, who became a nun. But I have no religious talent, and I do not propose to follow her example."

I think she was trying to tell me something. ■

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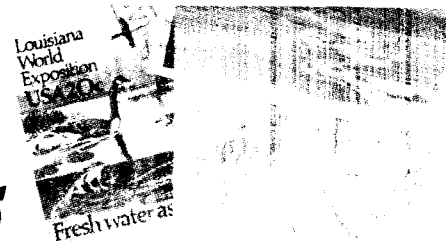
on gaming

Dana Lombardy



Benjamin Franklin may have started the United States Postal Service in order to pursue one of his many interests—playing chess with friends far away. Chess, and other abstract strategy games, have been played through the mail for many years. When commercial wargames were introduced in the early 1960s, special play-by-mail (PBM) kits were also made available for each board game.

Play-by-mail (PBM) games have kept up with the times. PBM versions of fantasy and SF role-playing games are options for gamers who can't always find other players or a gamemaster to run an adventure when they'd like to play.

Most of the new PBM games are designed and run by small companies, using personal computers to handle turns, moves, combat, etc. Requests for information were sent to more than fifty PBM companies, and the ones that responded are included in this survey.

This column can't go into detail on each PBM game, but a free pamphlet is available for readers who'd like to know more about these games. You can obtain one by writing to me at *Analog*, 380 Lexington Avenue, New York, NY 10017.

I also recommend several periodicals that cover PBM games (sample copies of each ma[illegible] *Gaming Universal*, [illegible], Lawley, PA 18428; *Flagship*, [illegible] Flying Buffalo Inc., Box 1467, Scottsdale, AZ 85252; *Space Gamer*, Box 18957, Austin, TX 78760; *Dragon*, Box 110, Lake Geneva, WI 53147.

PBM games enable you to play whenever you want, either solitaire, or interacting with other players through diplomacy or battle. Some games are run ("moderated") by a gamemaster or referee without the aid of a computer. Most PBM games use computers to handle paperwork and speed up play.

A game played through the mail could take years to complete—if it has an ending. Some PBM games have a fixed number of turns, or end as soon as a player achieves a predetermined victory point level. Many games are open-ended, going on indefinitely as long as you wish to continue the game.

Unlike a conventional game that you buy in a store and take home, PBM games are more expensive—not at first, but over the length of the game, which could be months or years.

All PBM games have fees for rules and set-up. Some require a deposit or several turns paid in advance. If you miss a turn, you may have to pay for it anyway. If you drop out without notice, or miss too many turns, you may forfeit your deposit.

(continued on page 88)

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THE BEST IN PBM

BEYOND THE STELLAR EMPIRE

Beyond the Stellar Empire (BSE) is a science fiction role-playing game of unparalleled scope. You assume the persona of an interstellar starship captain interacting in the most detailed play-by-mail game ever created. BSE has it all; a multitude of unique solar systems composed of individually designed worlds, politics, and diplomacy, realistic economics and logistics, a comprehensive combat system, chartered companies and Imperial services, alien races, and exploration, invasion, and colonization of hostile planets.

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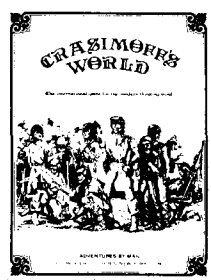
Beyond the Stellar Empire was chosen by editors of *GAMES* magazine as one of the top 100 games for both 1983 and 1984, the only PBM game so honored

Complete Rules Package costs $5.00. Starter Package costs $17.00 and includes rules package, set-up, and two turns.

CRASIMOFF'S WORLD



Crasimoff's World is a PBM game of extraordinary quality and detail. Lead your party of fighters, magic users and priests through a fantastic land filled with adventure, magic, and danger. Each party member has a wide range of attributes and possessions. Loot dungeons, redeem swampmen heads for bounty, explore ancient ruins, raid dwarven encampments, and battle hill trolls in their underground domain. The world is complete in every detail; history, ecology, mythos, geography, and much, much more.

Complete Rules Package costs $3.00. Starter Package costs $15. -includes rules package, set-up, and two turns.

CAPITOL

Capitol is a fast playing strategic space warfare game that divides players into teams, pitting them against each other in an orgy of xenophobic fury. Capitol is unique in that it is a perfect introductory game for an individual new to play-by-mail games while at the same time detailed enough for the most experienced gamer.

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Duncan Lunan

PROJECT STARSEED, OR, NUCLEAR WASTE SAVES THE WORLD

The difference between "trash" and "building material" may be just how you look at it!

In March 1978 the science fact article in *Analog* was "The Disposal of Nuclear Waste in Space: Will it Ever Be Feasible?" by Michael McCollum.[1] Among the subsequent letters in "Brass Tacks" there was one from me sug-

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gesting a European initiative, since burial of nuclear waste was then a big issue in Europe, particularly in the U.K., particularly in Scotland. It looked at the time as if Scotland was to get not just all of Britain's high-level waste but quite a lot from the rest of the world as well, and there was a demand for alternative disposal options.

In September 1979 I chaired a seminar on the space disposal alternative, under the auspices of ASTRA, the Association in Scotland to Research into Astronautics. The principal guest was Captain Chester Lee, of NASA's Space Transportation Systems Division. Unfortunately several other key speakers from the spaceflight side couldn't attend (one had to withdraw on the morning of the event!) and all but one of the speakers from the nuclear side suddenly remembered prior engagements, in fear as it turned out of a riot by ferocious Scottish demonstraters! Nothing untoward happened, but the curtailed program allowed us to do little more than define issues for further study. It's mainly for that reason that the results haven't appeared until now.

My first paper on the subject appeared in the *Journal of the British Interplanetary Society*, in April 1983[2] and brought an immediate reaction.[3,4] One encouraging development was that, although the United Kingdom Atomic Energy Authority describes space disposal as an unreliable alternative which is not being pursued, in fact expensive work has been done in the U.S.A. and Europe, unknown to me and evidently to Michael McCollum at the time when he wrote his article.[5] Nevertheless my independent findings haven't been faulted, so I'll stick to them here.

The first big surprise, for me, was that burial strategy is much safer than I had supposed. On paper the high-level waste scheduled for burial looks fearfully dangerous, but in fact the radioactive decay of the fission products over the first 600 years leaves the residue with less radioactivity than the uranium ore originally mined out. The remaining actinides (isotopes generated from uranium by neutron bombardment), have much longer half-lives, but that's because they're much less dangerous. You have to ingest the stuff for it to harm you, and even after 600 years you'd have to take in half a pound of it to have a 50% chance of lethal cancer.[6] What's more, it will be dispersed through glass blocks which have very low leach rates in water, and the vitrification technique is well developed; by 1978 it had been in use in France for several years. At Oklo in the Gabon, where natural nuclear reactors formed in uranium-bearing strata and eventually melted themselves down, the radioactive wastes stayed undisturbed for 1800 million years without any conscious effort at preservation (for a detailed account, see the 1978 *Encyclopaedia Britannica Yearbook of Science and the Future*), and the Scottish burial site was to be under a mountain, with the access tunnels blasted shut after use. Even an ice age wouldn't disturb it, and a meteor strike big enough to turn it up (solemnly considered) would be big enough to make nuclear waste the least of the hu-

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man race's worries. Finally, one repository would hold all the waste generated in the U.K. up to the year 2000, even anticipating a big expansion of the nuclear program in the 1990's, for a cost of just £100 million.[7] Since that would only buy five Space Shuttle launches at 1977 prices, the case for space disposal would have to be very good indeed.

Launch Safety

McCollum had asked whether the advent of Space Shuttle technology meant it would be safe to launch the waste out of the atmosphere. The answer to that at least was yes: in most foreseeable emergencies the Shuttle will separate from tank and boosters to glide back to Kennedy Space Center, or on to an emergency landing strip elsewhere in the world. Chester Lee assured the seminar that canisters could be built to protect the wastes in even the worst imaginable cases where the Shuttle exploded, and even to survive re-entry and impact. McCollum headed a section 'Never launch over water,' proposing liftoff from Vandenberg with emergency abort to KSC, but Chester Lee thought the prospect of the stack's falling on a populated area was much worse than a crash into the sea. McCollum wasn't right to talk about wastes "leaking from the containers" to contaminate large volumes of seawater: the canisters would remain unbreached, and after they corroded it would still take many thousands of years for the glass to leach away. If all the world's nuclear waste to the year 2000 were dumped on the seabed, and all escaped completely after a few thousand years, the radioactivity coming back to man through the food chain would still be less than the natural radioactivity of seawater.[8]

On crew safety, however, Chester Lee was tougher than McCollum. Adequate shielding for the crew compartment would reduce the Shuttle's payload to 12,000 lbs (5500 Kg). In the U.K. HARVEST process, the standard glass cylinder will mass 1.4 tonnes and the steel jacket approximately 3.5 tonnes, so only one could be carried per flight. A second vehicle would bring up a booster to carry the cylinder away from Earth. U.K. production of waste cylinders in the 1990's is expected to rise to three per week, and total world production by the year 2000 to be equivalent to 72,000 HARVEST cylinders . . . Space disposal using the Shuttle is only viable if the actinide wastes are separated out, leaving the fission products on Earth. Using the PUREX process developed in the United States, 40.8 kilograms of actinides are extracted from every tonne of heavy metal waste processed, so the UK disposal program would then be three actinide cylinders per year in the 1990's, with a further three flights to deliver the boosters. Even at that a year's actinide disposal costs more than the burial of *all* the country's wastes up to 2000 AD. Is it really worth it?

Target Areas

The road to an answer begins with the target options for space disposal, which were evaulated with the kind help of Professor Archie Roy at Glasgow

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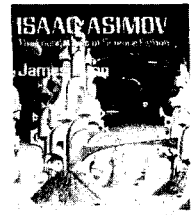

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University. The main choices advanced by McCollum were Solar Impact; Solar System Escape; Lunar Impact; Lunar Landing; Lagrange point storage. We also considered circum-lunar orbit; long-period cometary-type solar orbit; and my own suggestion of solar impact or Solar System escape using Jupiter slingshot, as well as the Marshall Spaceflight Center proposal for solar orbit, nearer the Sun, reached using ion-drive.[9] We ended up with straight launch out of the Solar System as by far the best option.

McCollum favored Lagrange point storage, in case we wanted to recover the wastes; but those orbits aren't truly stable without station-keeping. Lunar disposal just transfers the burial problem, if you think in terms of millions of years of lunar development. There aren't any circumsolar orbits which don't allow possible returns to Earth over the period in which the actinides are still active, and that also applies to solar impact trajectories if for any reason you happen to miss. All the Jupiter options require tracking and onboard course correction capability (Table 1); the launch window is only one month in 13. Whereas you can launch straight out of the Solar System any time you like, never thinking about the payload again, and it will be inert by the time it reaches the distance of even the nearest stars. The odds would be heavily against any waste canister's ever passing close to another star, and even then capture is very unlikely unless the system is multiple, in which case the odds are against there being any planets, let alone inhabited ones. Nevertheless, keep that thought on file till the end of the article.

Unfortunately in terms of rocketry, as McCollum correctly pointed out, So-

Getting Away from it All

Unfortunately in terms of rocketry, as McCollum correctly pointed out, So-lar System escape is beyond the current state of the art; but rocketry is no longer the whole of the art. With ideas currently around in the literature, such as mass drivers, solar sails, space elevators and skyhooks, it's possible in theory to dispense with the use of rockets in the Solar System altogether.[10] Stick with the mass driver, devised by Professor Gerard O'Neill, as a development of the "lunartron" concept for getting passive payloads off the lunar surface. If we had a mass driver in Earth orbit we would eliminate the need for booster stages in waste disposal; we could use the steel canisters as "buckets" carrying the payload, launching only the glass; and we could recircularize the station's orbit by returning the buckets to Earth, dropping into the atmosphere at near-zero velocity, as in the "Spaceport" system published in *Analog* by Arnold and Kingsbury.[11] I asked Professor O'Neill if it was feasible and he replied that "definitely" a mass driver could be built to launch 1.4 tonne payloads at solar escape velocity, from close-Earth orbit.

However, such a system could dispose of all the world's yearly output of actinide wastes in just eleven days. To make it economic we need to think big. There are designs for unmanned Heavy

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Method	V_B* kps	Launch windows Mid-Course correction Required?		Remarks
1 (a) Impact Moon	3.04-3.13	Frequent	Yes	Fast transfer less sensitive to error but has larger V_B
1 (b) Low circumlunar orbit	3.76	"	Yes	Lunar and terrestrial perturbations finally cause lunar impact
2 (a) 600 year interplanetary orbit	8.4	"	No	Possible Earth encounter after 600 years
2 (b) Impact Sun	21.3	"	Yes	Must ensure solar impact, unless ion meters used
3 Escape from Solar System	8.7	"	No	Time of transfer to distance of nearest star over 4 million years
4 (a) Impact Jupiter	6.3	Limited	Yes	-
4 (b) Low Circum-Jupiter Orbit	21	"	"	Retrofire required
4 (c) Impact Sun *via* Jupiter	6.8	"	"	Retrograde Jupiter hyperbolic flyby required; error sensitive
4 (d) To escape from Solar System	6.3	"	"	Time of transfer to distance of nearest star over 10^6 years

* N.B. V_B is total velocity budget to reach target from Earth parking orbit.

Table 1. *Summary of Spaceborne Nuclear Waste Disposal Methods.*

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Lift boosters using the Space Transportation System elements: the largest of them would use two tanks, two Main Engine clusters, and four solid-fuel boosters, giving a payload to close-Earth orbit of 220 tonnes—42 HARVEST cylinders, since we no longer have to shield a crew compartment. It would take four such launches per year to remove all the nuclear waste generated in the UK, and 250 launches for all the waste generated in the world in the year 2000. If we assume that launches in the 1990's average 120 per year, and that each launch costs the same as a manned Space Shuttle launch (the equivalent of 30 million in 1977 dollars), then the cost of a decade of space disposal would be 36 billion. That compares very favorably with, say, Project Apollo, whose cost was equivalent to 45 billion 1977 dollars, [12] but very unfavorably with burial—25 times as costly per cylinder, even before the cost of the mass driver is taken into account. Furthermore, although the program would begin with spare capacity and reduce the existing backlog of wastes, and might still be ahead up to the year 2000 because of the storage times before final disposal, on the existing plans for expansion of the nuclear industry there would inevitably come a time when larger payloads or more launches would be needed.

Looking for a Way Out

One favorite alternative (in spaceflight circles) to ground-based nuclear plants, is the supply of energy from geosynchronous orbit where it has been gathered by Solar-Electric Power Satellites (hereinafter referred to as powersats). Early designs offered to deliver 5 GigaWatts of energy at the ground receiving station and in more recent studies 10 GW is often taken to be the baseline. The power could be gathered either by arrays of solar cells, 12 km long and 45 sq. km in area, or else by using solar mirrors to focus heat to drive huge turbines—a giant version of the space station designs of the '50s. Delivery could be by microwave beams to huge ground-based "rectennas," or else by high-energy laser; both approaches have technical and environmental problems and I can't resist mentioning a marvelous suggestion from British Aerospace: laser supply to a huge tethered balloon up in the stratosphere and tight-beam microwave links to small, ground rectennas from there.[13]

So far in the literature there have been two main approaches to the creation of powersats. In the US aerospace industry the emphasis is on building powersats down here, assembling them in close-Earth orbit, and flying them out: Rockwell International Inc. proposes to have a 1 GW experimental powersat in geosynchronous orbit by the year 2000.[14] Moving out through the Van Allen belts is liable to damage solar cells, however, and the Boeing company favors the solar turbine approach. They believe that the first *operational* powersat of that type could be on station by as early as 1996.[15] But if you thought I was pushing it in proposing a Heavy Lift every three days, wait till you hear this: Boeing proposes 10 flights per day *each* with

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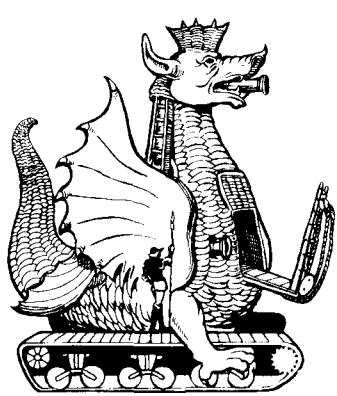

Characters begin the game as "normal" humans, but there is no limit to how powerful the characters can become. The gaming system is reasonably simple, with additional and optional rules that can be added as the basic rules are mastered. The game system even allows Game Masters to add their own rules, if desired.

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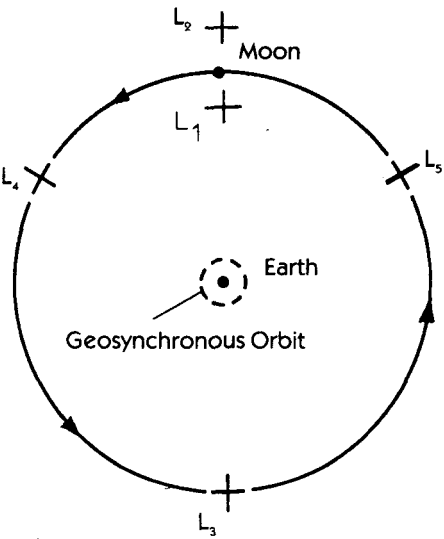

EARTH-MOON LIBRATION POINTS
Figure 1

a payload of 75,000 tonnes, equivalent to the daily throughput of a major international airport!

The alternative scenario, very familiar to *Analog* readers, is of course the powersat-building space colony as advocated by Professor O'Neill.[16] O'Neill's original proposals were for habitats in the form of paired, counter-rotating cylinders, each pair to house 10,000 people (Island One), and to finance itself by building powersats. Larger Island Two and Three habitats would follow with a variety of spherical and cylindrical designs. Raw materials would come from the Moon, gathered by surface mining of the lunar soil (regolith) and shipped out by solar-powered mass driver, to an intermediate collecting station at the L2 Lagrange point (figure #1) before traveling on to habitats at L4 and L5.

Two big design problems arose. Human beings may not be able to tolerate rotation rates of more than 1 rpm in simulated gravity conditions, and if a full Earth-surface equivalent 1-g is required then the radius of rotation works out at a full kilometer. Secondly, moon-rock lacks "volatiles" including the carbon, nitrogen and hydrogen required for life-support; they all have to be shipped out from Earth and there's a lot of empty space inside a cylinder to be filled mostly with atmospheric nitrogen. The same problems affect other Island One concepts such as the Sunflower and the Bernal Sphere, and as a result the "Stanford torus" concept evolved as a gigantic wheel, in the first of the "Sum-

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mer Studies'' held jointly by NASA Ames Research Center and Stanford University.[17]

Three further problems arise as regards powersats. The first is simple cost. O'Neill indicated a cost around five times that of Project Apollo; many enthusiasts thought it would be about the same as Apollo; but the late A.V. Cleaver, looking at the cost of Apollo in relation to earlier estimates, reckoned that Island One would cost anything between ten and a hundred times as much as the Apollo program.[12] The second problem is delay: even the Stanford Torus proposal, in which colony and powersats were built together, would take 13 years to produce the first powersats and 25 years to meet the energy needs of the U.S.A.

And the third factor is—how many powersats do you need? The 1975 Summer Study assumed an operational life of 30 years, as for ground-based power stations, and that might be true for solar turbine powersats. But their big attraction is that they can move out through the Van Allen belts. Powersats brought inward would presumably have the simpler solar cell design, and with no moving parts could last virtually forever. There might be an orbiting patrol in geosynchronous orbit continuously refurbishing solar cells, just as the Forth Bridge is continuously repainted. 50-100 powersats would be enough to run the U.S.A[18] and 500 at most would meet all Earth's energy needs next century. What's more, since 60% of US energy consumption is industrial,[19] the more heavy industry moves off Earth for energy, raw materials, or environmental reasons, the fewer powersats will be needed to beam to the ground.

The Starseed Germinates

In my second paper for the Journal of the British Interplanetary Society, I used the exploitation of the North Sea as an analogy.[20] In the 1960's the Pilkington Glass Age Development Committee published plans for a city in the North Sea, which aroused a great deal of interest,[21] but when the time came to go after the oil and gas nobody stopped to build the city—just bigger, stronger oil rigs, paying higher wages. When the world decides it wants powersats, something similar will happen, and since the Moon does have the silicon, oxygen, aluminium, and titanium needed for building powersats, the destination of the lunar mass driver payloads will be a lot more like an oil rig than like the Stanford torus.

The ''construction shack'' from which space habitats are built, tends to be mentioned casually as if it wasn't going to be the most ambitious space habitat of its time. Proposals by O'Neill and by Gerald Driggers, for example, have involved huge pressurized spheres for shirtsleeve working conditions—not impossible, but think of the development program! There are less ambitious ideas using Shuttle tanks, however, and the nuclear waste disposal program above would be supplying those to a rendezvous point in close-Earth orbit at the rate of 240 per year. The Starseed proposal which follows (so called because of its growth potential) uses them

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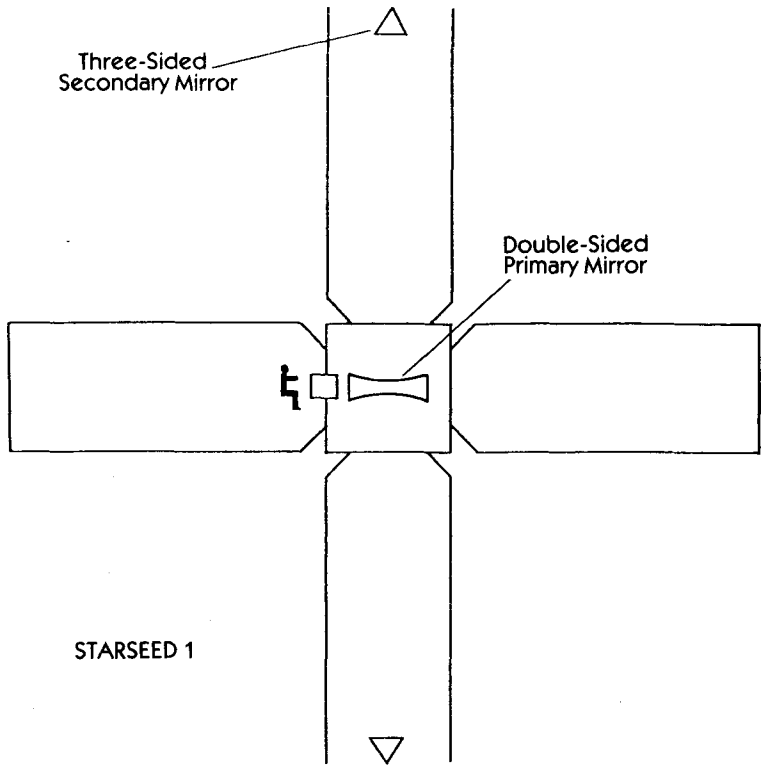

Figure 2

to generate a very sophisticated "rig" indeed.

Starseed 1 might begin as a manned orbiting observatory (figure #2). The original idea, formulated by John Braithwaite and myself, was for four tanks in cruciform shape, two of them open to space, a two-sided primary mirror and two three-sided secondaries. Braithwaite believes that every possible surface in a space telescope should be optically worked, and in theory this design allows use in 12 different modes. What's more, the main mirror would be spun when in use, to allow "blink scanning" of supplementary sensors mounted on the rim, and would act as a gyroscope; braked to rest against the structure when not in use, it would spin up the Starseed in the "horizontal" plane for simulated gravity.

Keeping the organic metaphor, I've

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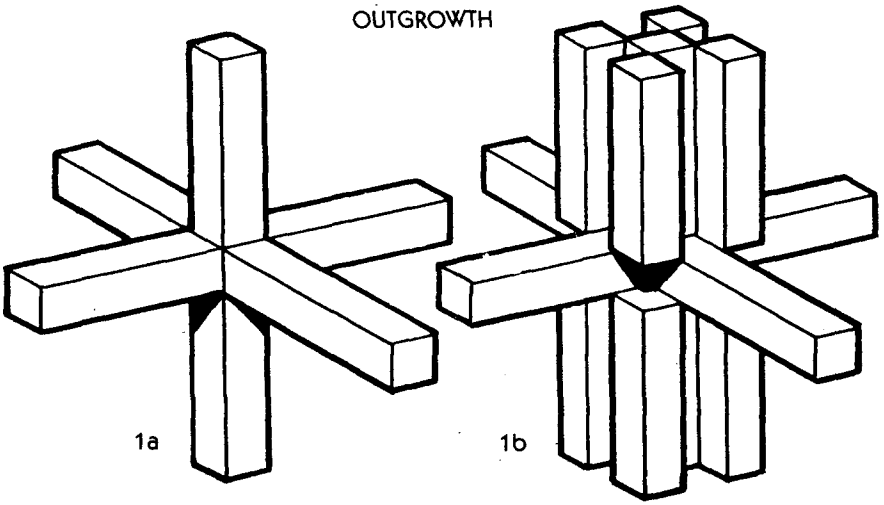

Figure 3A

Figure 3B

used the term "Outgrowths" for the expansion phases which follow. Outgrowth One begins by adding two more tanks in the horizontal plane, shown schematically in figure #3A, with extra segments added to the core module to give access all around. A further eight tanks are then added in the vertical plane, to be used for zero-g processing research and development. Because they are close to the axis of rotation, it should be possible to use these even in the simulated gravity mode. (Figure #3B)

As mass driver segments are shipped up and assembled, and as nuclear waste payload deliveries build up, Starseed construction gets under way in earnest. Delivering tanks in pairs is a great help because they can be added in opposite positions, retaining overall stability. Outgrowth Two (shown in cutaway in figure #4) adds 32 tanks, and by this time telescope operations will be compromised and the instrument will be removed to a permanent observatory. The same will happen to manufacturing processes which prove commercially viable, except that they will be duplicated, not removed: Starseed is building up into a very sophisticated orbital factory. Figure #5 shows a cutaway of the midpoint of Outgrowth Three, when 118 tanks would be in place; 72 more have to be added in the horizontal plane and 8 in the vertical, to complete the structure. 180 tanks of the total of 198, have simulated gravity: if we use 100 of these for living quarters, and divide them into 10 levels each 4 meters high, then O'Neill's construction shack work-

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force of 2000 can be accomodated at just two people per level. Another of O'Neill's concepts now comes into play: the mass driver engine, firing aluminum slugs to generate thrust equivalent to the Space Shuttle Main Engine,[22] now built on to the evacuated core of the station. Starseed is getting ready to move.

There are three possible work stations, all of which are in fact orbits requiring some station-keeping. The cheapest in energy terms is L5, but if the lunar base is to be on the Nearside, then payloads have to be caught at L2 and re-shipped; with mass driver engines firing moonrock, about 20% of the original output is wasted. Another option is 2:1 resonance orbit, which grazes geosynchronous orbit at perigee (figure #6); but although transfer velocities into and out of it are low, the launch window from L2 comes up only once every two months. The third option is a Halo orbit circling L2 at 10,000 km radius, which allows line-of-sight communications to Earth or at least to geosynchronous orbit, but is the most expensive in energy terms.

However if the factory is "at" L2, i.e. in Halo orbit, and the lunar base is on the equator at longitude 33.1°E(figure #7), then the spread of payloads arriving from the Moon is minimized. If the

Figure 4

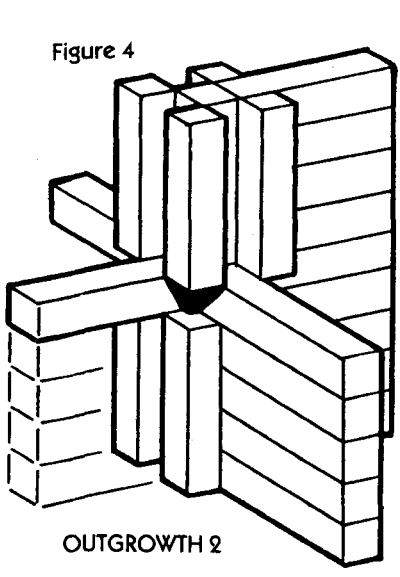

Figure 5

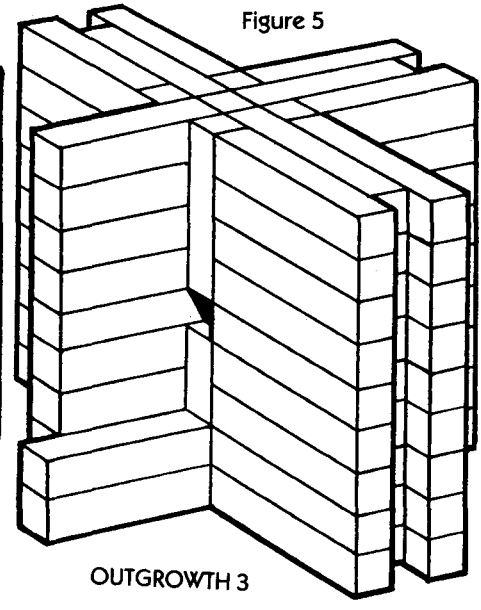

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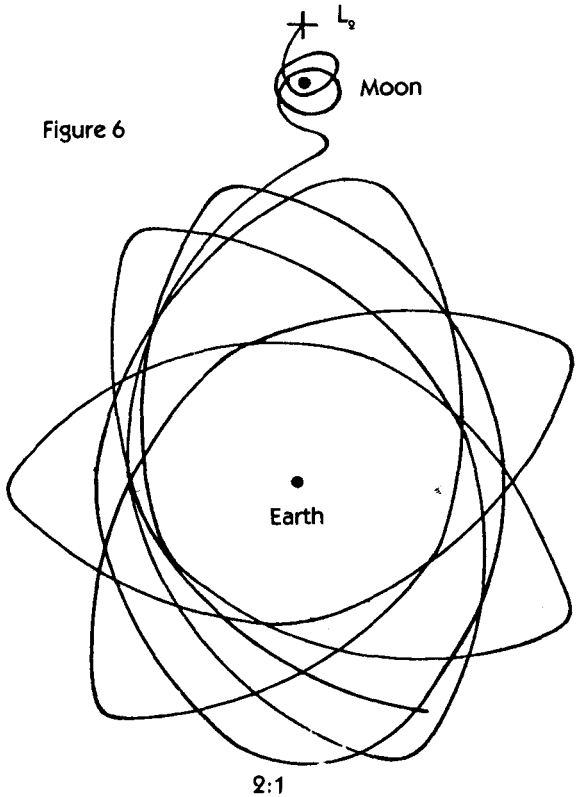
Figure 6



RESONANCE ORBIT

lunar base is supplied during the night with energy from solar mirrors or a powersat at L1, then the rate of delivery might be high enough for continuous processing. John Braithwaite suggested to me that the incoming payloads might be vaporized by focused solar mirrors at the top of the Starseed's central shaft, then drawn along it magnetically and separated in a gigantic mass spectrometer. Aluminum, titanium, silicon, and oxygen could be tapped off at the processing stages where they were required, perhaps (for the metals at least) for immediate vapor deposition. Better yet, the lunar grains' surface deposits of carbon, nitrogen, and hydrogen from the Solar Wind could also be reclaimed.

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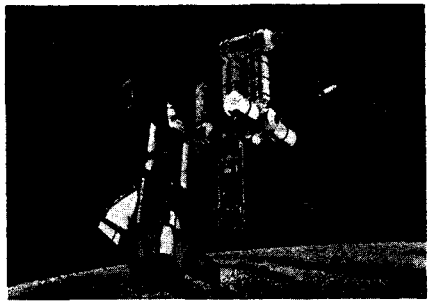

NEXT STOP:
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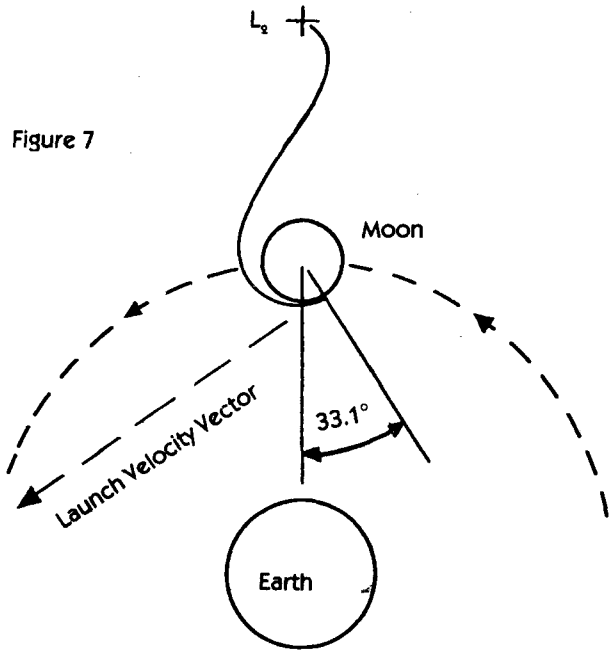
Figure 7



TRANSFER ORBIT—MOON TO L_2

Let us suppose that a Starseed can reach the output of a large ground-based steelworks—say, 60-70,000 tonnes per month, or a powersat each month in round figures. Suppose each year of nuclear waste disposal contributes another Starseed to the L2 workforce, and each Starseed takes a year to work up to full production. Then if waste disposal begins in January 1990, December 1999 ends with 9 Starseeds operational, and between them they have built 486 powersats, enough to supply the upper estimates of Earth's energy needs in the 21st century—not a bad note on which to start it. The projected expansion of ground-based nuclear plants in the 1990s need never happen and by the year 2010 the last of the existing nuclear wastes will be gone.

Beyond Starseed

There are many practical details covered in the Starseed paper,[20] but instead I want to look at what happens next, when we have a powerful mass driver in Earth orbit, a less powerful one at a manned base on the lunar surface, and 9 unemployed Starseeds at L2. Let's look first at three well-known scenarios

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and their less-well-known problems.

(1) To provide Earth-surface equivalent "gravity" in a space habitat it needs to be two kilometers across, and to be shielded from solar flares and primary cosmic radiation it needs rock shielding up to five meters thick. The conventional model has an aluminium hull, rotating inside a stationary rock shield, total mass around 2 million tonnes. D.J. Sheppard has suggested using prestressed concrete, from lunar materials, raising the mass to 10 million tonnes.[23] But to make Island One habitable 27,000 tonnes of hydrogen compounds, nitrogen, and biomass have to be supplied from Earth or obtained from Earth-grazing, carbonaceous chondrite asteroids.

(2) The "space elevator" concept, a tower stretching from the ground to synchronous orbit and as far on again into space, has been widely discussed although there exists no known material of sufficient structural strength. Lunar towers, to L1 or L2, could in theory be built of known materials such as Kevlar—but that requires bulk supplies of carbon compounds not available in moonrock.[24]

(3) The British Interplanetary Society's "Project Daedalus" considered an unmanned probe to Barnard's Star at 12% of lightspeed. Its mass at launch would be 50,000 tonnes, nearly all of it deuterium (common in nature) and helium-3 (very rare). To synthesize enough helium-3 in 20 years, the time allowed to build the probe, we would need reactors generating as much power as is currently used by Earth-based civilization; vast white-hot radiators would be needed to disperse the waste energy, on the lunar Farside for preference. Instead the planners proposed to collect the fuel from the atmosphere of Jupiter; but it would have to be done by unmanned vehicles operating from Callisto, because Jupiter's inner radiation belt is "superlethal" and too intense for any imaginable spaceship shielding.[25]

Great ideas, but very hard to realize from where we are now. *However*—

(1) In round figures, to build 500 powersats of 60,000 tonnes gives a finished product mass of 30 million tonnes, plus, from 1975 Summer Study figures,[17] 500 million tonnes of residues in the form of silicates plus steel—enough hull material, parked in 2:1 resonance orbit, to build 50 Island One's of the Stanford torus model as modified by Sheppard.

(2) According to Heppenheimer,[26] Solar Wind deposits on a million tonnes of moonrock amount to 340 tonnes of carbon, nitrogen and hydrogen. 530 million tonnes of moonrock should therefore yield 180,200 tonnes of volatiles, enough to make six Stanford tori habitable.

(3) What do we need 1-g habitats for? There isn't another solid body in the Solar System with surface gravity as high as that, and the object is to go forward from here, not back. Cut down the simulated gravity and you cut down the diameters, reduce the volatiles demand, go back to cylinders, and *make them mobile*.

(4) A fully fueled Daedalus probe launched from Earth would get to Mars

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in five days (including deceleration) for a total fuel expenditure of 200 tonnes. A metal habitat without rock shielding could get there in a fortnight for the same fuel expenditure, and concrete, cylindrical ones would do it in under a year.

(5) If one or more Starseeds go to an Earth-grazing asteroid, and the others at L2 catch the returning cargoes, we can build the lunar space elevator to L2, use the first Island One as a counterweight, build the second lunar base at its foot and launch moonrock, and helium-3, direct to the dockyards at L5. Incoming and outgoing materials open up the Moon and the Solar System simultaneously.

(6) Habitats shielded against primary cosmic radiation can enter Jupiter's radiation belts with impunity, and velocity changes in Jupiter's gravity well are equivalent to trips between the inner planets, so mobile habitats can "mine" Jupiter's atmosphere from close orbit, much more efficiently than in the B.I.S. study. Once we have access to Daedalus propellants in quantity, we can have habitats out among the comets in 200 years; at Alpha Centauri in 400 years; at Barnard's Star in 600 years; and spread through the Galaxy in ten million years—and all of it, beyond the Starseed program, at little or no further cost to Earth. Even the Starseeds pay for themselves by revenues from powersats and orbital factories, so the initial Apollo-equivalent investment gets its money back and the whole of the Milky Way for a spinoff.

Michael McCollum's 1978 article concluded with the idea that the expanded space program for nuclear waste disposal might lead to much greater things. Who would have thought, he asked, that the key to space would prove to be slightly radioactive? Well maybe some day, millions of years from now, a mobile habitat will be checking out the Lagrange points of a multiple star system for interesting resources. Isotopes from a supernova cloud, maybe, swept up and captured by the interacting gravitational fields of the system. In among the comets and the dust, they may find a cylinder of glass, curiously heavy, about two meters long, and almost totally inert. And when the computer links tell them what is is, they can look around the starclouds of the Galaxy, reflect on all that's going on out there, and tell themselves that it was a few thousand of these which got the whole thing started. ■

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James White

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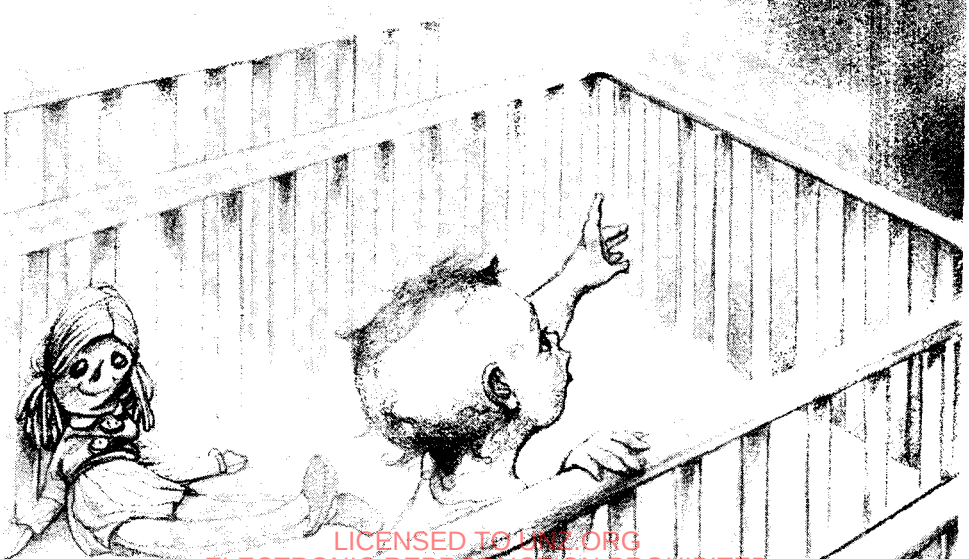
Judy Mitchell



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The trouble with VIP visitors, Gregory thought as he glanced impatiently at his lapel watch and around the uncharacteristically tidy ward, was that they invariably arrived late, and their lack of punctuality varied in direct proportion to their degree of importance.

An eminent consultant, usually through no fault of his own, was expected to be a few minutes late. A high Government official, ignorant of the ward's particular problems but with the power to provide much needed funding for additional medical staff and equipment, could keep them waiting anything up to an hour. But when the visitor was a very important person indeed and the representative, it was rumoured, of a Government encompassing many hundreds of inhabited solar systems, the degree of impunctuality became impossible to forecast.

From the corridor there came the sound of light, hurried but undoubtedly human footsteps and Doctor Pearson entered. Without waiting to catch her breath, the pediatrician said, "It's here, Charge Nurse. In the . . . administrator's office . . . being introduced to heads of department and having coffee before. . . ."

"Coffee?" said Gregory.

Pearson smiled and said, "I fully realize, Charge Nurse, that the hospital's coffee is unfit for human or extraterrestrial consumption. The visitor is being offered coffee as a gesture of politeness, but I have no doubt that it is too highly intelligent to accept it.

"But I sneaked out to tell you that this ward will definitely be visited," she went on quickly. "There was some discussion about excluding places which the visitor might find unpleasant or emotionally disturbing, but it insisted that you remain on its itinerary. It's due here in about twenty minutes. Now I have to get back to the others."

"Wait," said Gregory as she turned to go. "What is it *like*, Doctor?"

The nurses grouped behind him edged closer, but Pearson shook her head apologetically. "I can't describe it exactly. It isn't ugly, especially if you like horses, and it has a lot of hands and arms, six I think, but no legs. It speaks very well but sometimes it asks very awkward questions." She smiled up at him. "You'll find out for yourself soon enough. See you."

Before he could reply there was a sudden, loud rattling sound from a cot at the other end of the ward. Michael, one of the spina bifida cases, started crying and Mary in the next cot began making the strident and unmusical hooting noises which she believed were singing. Within a few seconds the crying and cot-rattling was general and the first few soft toys were crash-landing in the middle of the highly polished floor.

Things, Gregory thought wryly, were returning rapidly if prematurely to normal.

"Calm them down, for God's sake," he said with quiet urgency. But his four nurses were already heading for the centers of disturbance armed with the nonmaterial weapons of their profession. Gregory stooped quickly to pick up a yellow plastic duck with teeth-marks in its head and wagged an admonishing finger at its owner before tossing it back. Doctor Pearson's footsteps were already fading along the corridor.

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Twenty minutes, she had said.

Picking up discarded toys, tidying rumpled bed linen and returning the smiles and gurgles and blank stares alike with reassuring noises or a pat on the shoulder, he moved unhurriedly down the ward. The idea was to project reassurance and an atmosphere of calm. In spite of their various disabilities, and often because of them, the patients were hypersensitive to atmosphere. The slightest hint of uncertainty, irritation or impatience displayed by the medical staff could be magnified by their small charges to the point where the sitaution could get quickly out of control, after which it would require much more than twenty minutes to restore the general emotional equilibrium. But the girls were already calming down the little terrors—except at the other end of the ward where Nurses Hayes and Nelson were encountering problems, the usual problems, with John and Jenny.

"There, there, John," Nurse Hayes was saying as she gently but firmly detached the tiny fists from the bars of the cot. "Lie back, now, and be a good boy. That racket is frightening your girlfriend half to death, and you wouldn't want to do that, would you. Stop shouting, or Jenny won't even want to talk to you. . . " She ducked her head quickly to evade the hands which had grabbed for her spectacles, then straightened up, wrinkling her nose.

"Oh, John," she went on, "I changed you not ten minutes ago . . . Charge Nurse, do you think the visitor, being an alien and all, would know a bad smell from a good one? How much time do we have?"

"Enough, I'd say," Gregory replied, watching Jenny whose crying had taken on a note of desperation. "Change him again. According to the book, when they are clean, comfortable and well-fed, they will be more relaxed and amenable to suggestions—like cutting out that racket—from the nursing staff."

"Theoretically," said Nurse Hayes, already at work.

"Theoretically," Gregory agreed, smiling. John gave a single, loud whoop then lay back and smiled silently back at him. Jenny was still crying as though she would never stop.

In addition to a number of congenital defects which would ensure that she would not live to see puberty, Jenny had cerebral damage and was unsighted. There were times when Gregory tried to imagine the dark confusions the three-year old experienced via her severely limited sensory channels, and the form which the nightmares and occasional happy non-visions took in that innocent but flawed young mind—but he did not dwell on such imaginings for long because they were apt to spoil his sleep. Nurse Nelson had lifted Jenny from the cot and was holding her against her shoulder and using the free hand to pat the child's back. Jenny had her arms wrapped tightly around the nurse's neck, but her bright, tearful, blind eyes were seeing something that made her unconsolable.

Gregory put out a large hand, fingers spread loosely open, and placed it very gently on Jenny's head, enclosing the top and back of the tiny cranium and holding it as if it were a fragile and delicate fruit. She stopped crying and her hands went to his wrist and she began trying to uproot some of the hairs

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there. Gregory winced and brought his thumb gently down across the forehead like a fleshy visor to rub away the tears.

"How does he *do* that?" said Nurse Nelson. "And without even saying a word!"

Without looking up from John, Hayes replied, "He has this strange attraction for small girls, and vice versa. One would think that with a hulking, hairy brute like him coming at them, nothing personal, Charge Nurse Gregory, any girl whatever her size would run away screaming, but instead . . . Stop wriggling, John, that's a good boy . . . Instead, well, do you think Doctor Pearson has been able to—"

"Doctors and nurses," Nelson broke in, "frequently get married."

"Yes," said Hayes, pulling up John's pyjamas. "Great big macho doctors marry poor little overworked nurses who escape from the wards to the home kitchen, where they thereafter remain, barefoot and pregnant, as mere chattels of their medical lords and masters."

Nelson laughed and moved Jenny, smiling now, to cradle her against the other shoulder. She said, "He does some odd things at times, does our Charge Nurse, but I can't see him getting pregnant. As for Pearson, it must be like being engulfed by an amorous avalanche."

"Yes," said Nurse Hayes wistfully, and added, "Sometimes, if the genders are opposed and the emotional conditions are right, nurses have been known to marry nurses."

"Go ahead and talk among yourselves, ladies," said Gregory drily, "as if I weren't here."

He had arranged Jenny's pillows to support her in a comfortable and nearly upright position for viewing by the visitor, if it should be interested in the case, and spread her toys around within easy reach. They were the oldest items in the toy locker and many of them were simply odds and ends, but it was the feel and shape of objects that Jenny found interesting, not their colors.

"We wouldn't want to talk about you behind your back, Charge Nurse," said Hayes, patting John on the head and tucking his blanket around him. "Lie there quietly, John lad, and behave yourself. Do you think she was able to? Doctor Pearson, I mean?"

"Fight him off, do you mean?" asked Nelson, laying Jenny back in her cot. "Or ambush him into making a successful assault? Would the Charge Nurse care to comment on this delicate matter?"

Gregory reached down to smooth back the hair from Jenny's face. She looked up at him and laughed suddenly, but he knew that her eyes were simply following the sound of his breathing. Straightening up, he said, "No."

Nelson stood back from the cot and took a deep breath, which further enhanced the contours of her already spectacular chest, and began, "Now if I were in Pearson's place I would . . ."

They did not find out what Nelson would have done because Nurse Day, who had returned to her position by the entrance, was waving urgently and pointing down the corridor. Their visitor was arriving, Gregory thought after a quick look at his lapel, nearly ten minutes early.

Once again they lined up inside the entrance, with Gregory watching the arc

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of the corridor visible to him and watching his nurses give their caps a final straighten and smooth nonexistent wrinkles from their aprons. He waited anxiously as the sound of voices, one of them so clear and accentless that it had to belong to the visitor, drew nearer accompanied by the shuffling of at least twenty pairs of feet. He swore under his breath as he thought of the unsettling effect of that many people on his patients, to say nothing of the reactions to the visitor itself.

The extraterrestrial came suddenly into view. Gregory was only vaguely aware that it was flanked by Doctor Pearson and her department head, Professor Cunningham, and that the corridor behind it was a mass of white coats, because all of his attention was on the being itself.

Pearson's description, so far as it had been possible to go in a few sentences, had been a good one. The head, which was horselike but without ears, was partially covered by a narrow triangle of pale blue fur that began between the large eyes and widened to cover the upper scalp and the back of the neck. There was a wide-lipped mouth, unusual only in that it opened vertically rather than laterally, whose teeth were not visible. Between the eyes and the mouth there were a number of deep fissures and fleshy proturberances that probably included the aural and olfactory organs. The head was supported by a broad, triangular neck that widened to join the dumpy, cone-shaped body.

There were six narrow, four-fingered hands, in vertical rows of three on each flank, but the bony structure of the arms was hidden by the convolutions of a black, cloak-like garment which twinkled quietly as if it had been formed from a piece of the midnight sky. He could not see the visitor's legs, if it had any, because the cloak fell to within a few inches of the floor. But from the slight forward and backward motion of the being as it moved, Gregory suspected that it progressed in snail-like fashion on one or more sets of pads.

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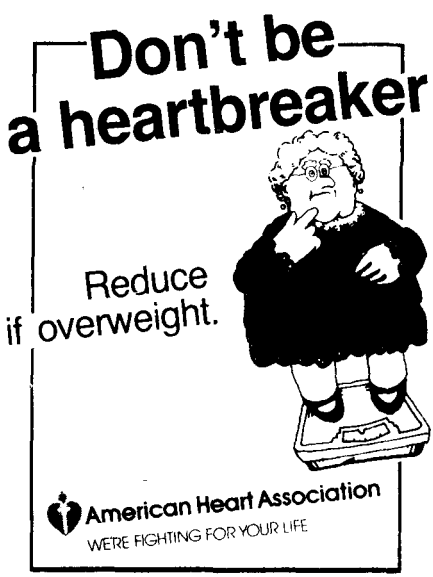
"This is Charge Nurse Gregory," said Professor Cunningham, "and Nurses Hayes, Nelson, Day and Bannion. I have already explained the ward staff's duties and responsibilities, and should now explain that among the visitor's species the practice of shaking hands is not performed expect in very special circumstances."

"The experience," the visitor joined in, speaking in a deep, rich voice which did not seem to be coming from its mouth, "would be disconcerting and probably unpleasant for both of us, Charge Nurse."

The other's eyes were just above the level of Gregory's waist, and they were regarding him with an expression that reminded him of the many times in his boyhood when he had to face a teacher with his homework undone and no good excuse ready. It was ridiculous. He was towering over the being and yet he felt sure that it was looking down at him.



As he inclined his head in an abbreviated bow he wondered if bowing, too, was something which was done only in very special circumstances.

"If I might make a suggestion, Professor," said the visitor, turning its large and inhumanly wise eyes in Cunningham's direction. "I suspect that a large number of persons accompanying me might give rise to emotional discomfort among these patients, and for this reason would you mind if I was escorted only by the entities Pearson and Gregory?"

Is it telepathic, Gregory wondered, or just very well briefed?

"Of course not," said the Professor.

Looking as if it were riding on a wheeled rocking chair, the visitor moved into the ward and came to rest between the first set of cots. Its eyes regarded the area of floor between them and it did not speak. The silence lengthened and Pearson began to look uncomfortable, which was the way Gregory felt.

"This . . . this is the ward that treats congenitally and otherwise damaged young children," she began awkwardly. "Our equipment here is pretty basic and . . . and you might not find it very interesting or . . . I mean, sir, the facilities in our new intensive care and neurosurgery units are among the most advanced in the . . ."

She broke off and her face reddened with embarrassment as the visitor turned its eyes on her, and Gregory squirmed inwardly in sympathy. All things were relative and to this being, who was one of the first few dozen to visit Earth in ships that traveled many times faster than light, the difference between the facilities of this ward and those of the

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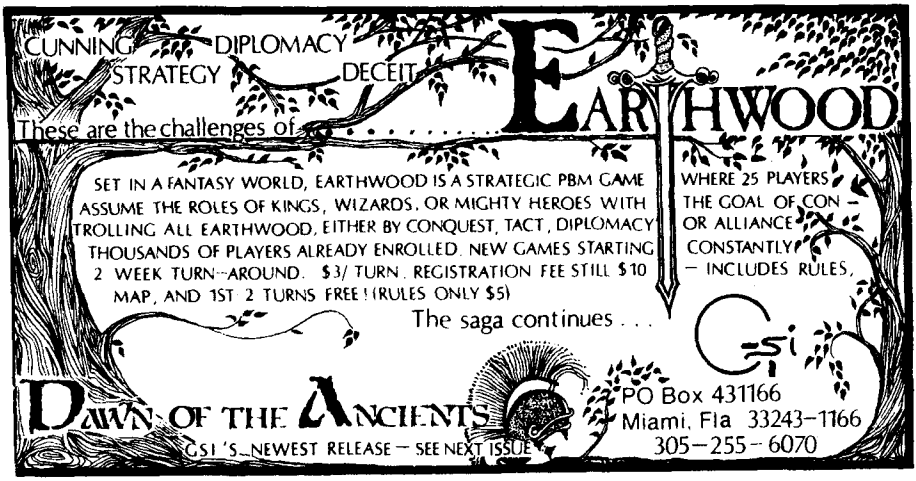
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glossy new intensive care unit would be like differentiating between the charms on the necklaces of two witch-doctors. As Pearson's subordinate he was breaking medical protocol by speaking out of turn, but he wanted to get her off a very embarrassing hook.

"This is Thomas," he said, indicating the tiny, wide-eyed figure staring at them from the nearest cot. "He is just under two years old, a spastic recuperating from an operation performed ten days ago. The dressing attached to the cranium can be removed if you wish to examine the wound and sutures. Subject to Doctor Pearson's approval he should be discharged and return to his parents in another three days."

"The condition has been cured?" asked the visitor, moving closer and doing something to its garment that made the area below the front of its neck become a mass of moving and interweaving colored lights. Thomas crowed in delight and extended his thin, trembling arms towards the extraterrestrial, who moved back before the hands could touch it.

Pearson cleared her throat, indicating that she was ready to take over again, and said. "Well, no. Thomas is suffering from a congenital abnormalty that we call spastic quadriphlegia, which causes varying degrees of paralysis in all four limbs. The condition is in an early stage with this patient, but is expected to worsen. The operation was largely exploratory and will, at best, alleviate the . . ."

She broke off, then went on apologetically, "The Professor did not introduce you by name or title, sir, or give me any information on your medical specialty. I have no idea of the depth or otherwise of the clinical information you require. Am I being too technical for you, sir?"

As soon as she finished speaking, Pearson reddened again at her unthinkable presumption that the visitor might not be able to understand anything she had said, that in certain areas it might

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be ignorant. But if it performed the exterrestrial equivalent of pinning her ears back, the visitor did so very gently.

"I feel sure that my translation device is equal to the task, Doctor," it said, looking up at her. "The exact nature of my work is difficult to define, but I am used to working among or observing beings who are in need of assistance. Regarding my personal name, this is used only by members of my family and close personal friends, and to us the Earth habit of exchanging names at first meeting is a strange one indeed. In any case, my race has other means of identification for casual or professional contacts which you, Doctor, would find equally difficult to grasp.

"If you wouldn't mind," it added, moving diagonally across the ward, "I would like to see the patient with the large head, over there."

It was certainly picking the bad cases, Gregory thought.

"This is Richard," said Pearson firmly. The visitor might find it strange, but it was obvious that she intended to go on identifying her patients by name because it was the only way she knew how to do it other than using their case-file numbers. "He is suffering from congenital hydrocephalus which developed during fetal life. The condition is caused by an excessive accumulation of cerebrospinal fluid within the cranium, and there is not a lot we can do for this patient apart from providing palliative medication."

Richard's face was changing rapidly from pale blue to red to yellow and green as the neck of the visitor's cloak radiated its patterns of color, but there was no change in the patient's expression. The light show stopped and, without speaking, the visitor moved to the next bed.

"This is Mary," said Pearson quietly. "A spina bifida case, three years old, admitted for further surgery. The prognosis is—"

"Thank you, Doctor," said the visitor, turning away, its garment retaining the dark brightness of a star-crowded night sky. Mary was sleeping. It added quietly, "Is this another congenital defect?"

"Yes, sir," said Pearson defensively. "There is very little that we can do for such cases."

The visitor stood for a moment in the middle of the ward, looking all around it as the whole of its garment rippled suddenly into glowing color as if it were a magician's enchanted cloak. With a few exceptions the patients watched or waved their arms or crowed with delight, and Gregory could not remember an occasion when so many of them had looked so happy at the same time. This visit would leave a memory, he felt sure, that would never completely fade—even from minds which were flawed and retarded. Their excitement was intense, but quiet, except at the bottom of the ward where John was standing again and rattling his cot sides. The visitor headed in that direction.

"Shush, John," said Pearson as they came up to him. To the visitor she went on, "This is a Downs syndrome infant, more commonly known as a mongol. It is a congenital disorder associated with an abnormality of the chromosomes and results in a severe degree of defective development of the mental processes. Fortunately, John shows no

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signs of the congenital heart disease that often accompanies this condition. He is a physically healthy child who will—''

''Why was the condition allowed to reach this stage?'' the visitor broke in.

Gently, Pearson detached one of John's hands which had grabbed a pocket of her white coat and was threatening to tear it off. She said, ''We do not possess the medical knowledge or ability to cure the condition, either pre- or post-natally. Now that we have been visited by several extraterrestrial races, all of whom are obviously far more advanced than we are, we are hoping for their assistance with this and many other problems.''

''You misunderstand me, Doctor,'' said the visitor. ''I was asking why such births were allowed to take place?''

Pearson looked away for a moment, toward the ward entrance where Professor Cunningham was standing and making chopping motions with one hand, then she said, ''There is no simple answer to that. We can give advice and even warnings, but it is a matter for the parents whether or not conception takes place. When it does, even accidentally, it is still a matter for the parent or parents whether the fetus, which we know beyond all doubt will be abnormal, is to be born. It is a complex problem involving medical ethics and the rights of parent and offspring, and no amount of debating has led to conclusions that satisfy everyone. But if you'll excuse me, sir, the Professor is indicating to me that we may be taking up too much of your valuable time here. There must be other departments you wish to visit.''

Without taking its eyes off John, the extraterrestrial said, ''I shall visit them if there is time. My purpose in coming to this hospital or, more accurately, my instructions, were primarily to visit this ward and report my findings.''

Gregory swallowed and looked at Pearson. She was staring back at him and it was plain that she, too, was trying to grasp the implications of what the visitor had just said. For a long moment neither of them spoke.

''Charge Nurse,'' said the extraterrestrial suddenly, ''have you anything to say?''

''I, well,'' began Gregory, then he cleared his throat noisily and went on, ''We cannot solve this problem, all we can do is handle the results to the best of our ability by caring for the patients. Doctor Pearson has suggested that with the proper help from you, or another race better qualified in this particular field, we might cure these cases and so avoid the ethical conflict which . . . Are your people able to help us?''

He was unable to read the other's facial expression, but there was a strange stillness of its head and the alien features seemed to take up subtly different positions before it spoke.

''I do not belong to the most able race in the inhabited Galaxy,'' it said in a quiet voice that somehow made the back of Gregory's scalp prickle. ''We are the Durrenneg'en. More than any other intelligent species we are the explorers, the surveyors, the directors, and the administrators. Our technology is more advanced than is possible for you to conceive, and with pardonable pride, I believe, we admit to being the second best, since the race generally acknowledged to be our superior is as far above us as we are above the other intelligent

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inhabitants of the Galaxy. I tell you this not to over-awe you, but simply to inform. Your respect for us is deserved, but any flattery or self-abasement before us would merely irritate. There is very little that we could not do for you or any other race, if it were necessary to do it."

"Then you *can* help these children?" said Pearson excitedly. "Or rather, help us to cure them?"

"Probably not," the visitor replied gently, "because the problem is largely of your own making and the solution is in your own hands. The answer lies with the parents or would-be parents and in improved methods of educating them. I sympathize, but your patients should never have been born."

"But they *have* been born!" Gregory burst out, loudly enough for the Professor waiting at the other end of the ward to stop waving at them and look anxious. "We must do everything possible for them, dammit, including asking for your help. John here, for example, is a—"

"That's enough, Charge Nurse," Pearson broke in sharply. To the visitor she said, "Please forgive him, sir. There are times when he becomes too deeply involved with his patients, and seems unable to understand why others are not equally concerned."

She was glaring at him more in concern than anger, Gregory knew, and silently urging him to be careful. She could also have told the visitor that he had a reputation for speaking out of turn; that his qualifications and ability entitled him to a much more senior post in the hospital, to a teaching or supervisory position, and that he had been appointed to this particular ward because none of the other senior nursing staff wanted the job. But Pearson would not say any of these things because they had grown very close during the few months since she had joined the staff, and she would say or do nothing to hurt him.

"With respect," said Gregory more quietly, "not all the parents are uneducated or careless. Many of these conditions occur spontaneously or for reasons we do not yet understand, and are nobody's fault. Perhaps you could assist us with these cases. Granted that if your treatments were widely applicable we would use them to try to cure the others because, regardless of their parents' ignorance or irresponsibility, the patients themselves are not responsible for their own condition. They should not suffer for something that is not their fault. After all, they did not ask to be born."

"Charge Nurse," said the extraterrestrial quietly, "in my considerable experience of the widely varying life forms who inhabit this Galaxy, I have yet to meet an entity who did ask to be born."

Gregory felt his face growing warm. He took a deep breath and went on. "John, here, is mentally subnormal but is otherwise healthy. He is a very affectionate child, surprisingly sensitive to atmosphere and has a great capacity for the enjoyment of quite simple things. In my opinion, and taking into account his limitations, he should be given the chance to lead the fullest life possible for him, and—"

"And in time," the visitor finished for him, "to produce others of his kind whose minds are similarly flawed?"

"In such cases," said Pearson quickly,

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trying to avoid another verbal collision between Gregory and the visitor, "there is always a conflict between the rights of the individuals and the correct course of action from the purely genetic standpoint. There are those here who hold that all life, and not just sentient life, is sacred. I wouldn't go that far, but in a perfect society we would not. . . "

"Dump people like John in the scrapheap," Gregory broke in. "I wouldn't do that to a dog!"

"There is only one race, the Illoel, who have achieved anything close to perfection," said the visitor, not looking at Gregory. "We ourselves are far from perfect, although we are constantly striving toward that goal as are many of the other intelligent species known to us. But there are other species who seem to be incapable of ever achieving their full potential. In several respects they resemble your patients. Their sentience is occluded, their emotions are misdirected and uncontrolled, and they are incapable of looking after themselves and must be protected from environmental dangers and from each other.

"Yet these races, if they would behave and think logically," the visitor went on, "could progress steadily and make a valuable contribution. Instead, they refuse to recognize their own weaknesses and, when they do, they are loath to do anything about them. This is intensely frustrating for our people who are trying to advise—"

"Are you saying," Pearson broke in, her face as white as her crisply starched coat, "that we are mentally and culturally subnormal? Is the whole human race afflicted with Downs syndrome?"

"I am merely saying," the visitor replied, "that perfection must be striven for, by long, hard and, at times, painful effort. It cannot be bestowed as a gift." Its head turned toward Gregory as it went on, "The close affinity your people have for dogs and other non-sentient creatures you sometimes choose as companions is very strange indeed. We have not encountered such behavior elsewhere."

"This striving for perfection," said Gregory, trying hard to control the anger in his voice because in the next cot Jenny was beginning to look frightened. "Is there any place for feelings, human feelings like sympathy and pity and—"

"Only when the feelings are properly directed and used constructively, Charge Nurse," said the visitor.

"I don't believe this!" Gregory protested. "Dammit, there must be somebody who can help our patients, at least. They haven't done anything to deserve . . . I want to refer the matter upstairs, to your superiors!"

"A full report of everything that has transpired here will be made to my superiors," said the visitor quietly. "The decision regarding medical or any other assistance is not mine to make, Charge Nurse."

"I've heard that excuse before," said Gregory. "Among us morons it means that somebody is passing the buck."

"Shut up, Charge Nurse," said Pearson angrily. To the visitor she went on, "Please excuse him, sir, and his inexcusable bad manners. Sometimes he feels too strongly for his patients, as do we all. I hope you will not have to mention his behavior to—"

"My report," the visitor broke in,

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"will most certainly include details of the behavior and verbal reactions of Charge Nurse Gregory and everyone else I have met, but rest assured, Doctor, it is not for the eyes of your superiors here. Thank you both for your time and co-operation, but now I must leave you."

"Wait, please," said Gregory fiercely. He bent over Jenny's cot, lifted the incredibly light body in his large hands and then cradled her in one elbow while he smoothed down the tiny robe so as to conceal the wasted lower torso and legs. He brushed aside the rumpled curls which were hiding one side of her face. Slowly, then, he lifted her in both hands and moved her until she was only a few inches from the visitor's face.

The extraterrestrial moved back, but only a few inches, then stopped.

"This patient," he said in his coolest and most clinicial tone, "is unsighted and suffers from congenital abnormalities that will ensure her termination before the age of puberty. None of these flaws, therefore, will be propagated. Is there not a case here for the alleviation or cure for her condition, an aspirin for one tiny headache, which I have no doubt an advanced species like yours could provide? Surely the people who can find their way through the limitless immensity of space can chart a path within the micro-universe of a child's damaged brain, and repair it?"

The visitor did not reply, and Gregory added quietly, "Do you not feel a need, an obligation, or even a faint urge to help this child?"

Jenny put out her hands and touched the visitor's head. She jerked them back, then reached forward again. The extraterrestrial did not move, and when it spoke its eyes did not leave the child's face.

"I'm sorry, Charge Nurse," it said. "Such a cure is not possible for my race, since our talents lie in other directions. While there are species capable of providing what you want, you would refuse their help. There are no medical miracles, as you very well know, and even a simple painkiller is the result of long experimentation and research, and the methods of the beings who would conduct this research would be abhorrent to you. Since talking to you I know this to be so. You must find your own cure, as you undoubtedly will if you can force yourselves to try hard enough."

No longer frightened, Jenny's hands were feeling all around the strange and tactilely intriguing contours of the visitor's head. Still it did not move except to close its large eyes when the tiny, exploring fingers came too close to them.

"My feelings," it went on, "are difficult to describe with accuracy, because I have never before been placed in a situation like this one. Logic tells me to ignore them. I am sure, however, that I am suffering from a temporary emotional confusion and that there is nothing of value in this situation."

Gently it began to disentangle its head from Jenny's tiny hands and arms. She tried to hug it tighter, reluctant to let go of this most unusual shape. Suddenly she pressed her face against the side of the visitor's vertically opening mouth, and she laughed. The sound was so joyous that for an instant everything in the ward seemed to stop. All the other children, the nurses and Professor Cun-

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ningham in the entrance were staring in their direction, and smiling. Gregory swore under his breath and Pearson blinked rapidly and turned her face away. The visitor moved away and there was silence for a few seconds before it spoke.

"This changes nothing, Charge Nurse."

As it moved up the ward to rejoin the Professor, Gregory tucked Jenny back in her cot. She was still laughing.

As a trusted and able servant long in the confidence of its superiors, the Durrenneglenian felt obliged to add its own personal recommendations at the conclusion of the report.

"I found the race to be backward, unstable, illogical and in many respects flawed," said the Durrenneglenian. "They are not capable of taking care of themselves. Without our continuing attention the planet's inhabitants would long since have destroyed themselves, and I am surprised that you maintain the protective surveillance. The people are confused, uncoordinated and overly emotional. With respect, we are wasting our time and resources. On Earth there is nothing of value."

In the manner of a superior addressing an old and valued servant and near-friend whose behavior had been a minor disappointment, the Illoel's reply was gently critical.

"The Durrenneglen are a highly intelligent, cultured, and extremely able race but you, too, have a flaw. Did it not seem unusual to you that we sent an administrator of your elevated rank on what appeared to be little more than a sight-seeing tour? The visit to Earth was intended to make you aware of this flaw. You should have realized that, in spite of the backward state of their present culture, a great many of its people have a very rare quality. They know instinctively what is right, and they insist on doing the right thing against all the dictates of logic and in spite of the pain and effort it costs them or the complete lack of reward. The faculty is still dormant, and they are as yet unable to appreciate their unique quality, but even now it is strong enough to resist the opposition and arguments of a Durrenneglen senior administrator who could not recognize this insistence on expending effort and resources without the expectation of reward, for what it is and will one day be.

"They need more time. Protective surveillance will be maintained. On Earth there is something of value." ■

Gardner's Rule of Civilization, as He Knows It

● The society which scorns excellence in plumbing because plumbing is an humble activity—but which tolerates shoddiness in philosophy because it is an exalted activity—will have neither good plumbing nor good philosophy. Neither its pipes nor its theories will hold water.

Jerry Buchmeyer

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ON GAMING

(continued from page 52)

Most PBM games cost about $3.00 per turn to play. A "fast" PBM game would be one turn completed every two weeks. An average game plays at the speed of one turn per month.

Some PBM games involve a story that you participate in. You interact with the gamemaster as one or more characters, such as a wizard, thief, warrior, etc. The story has no fixed plot or ending—you're "writing" it as you play. Such role-playing can be done solitaire (just you and the referee/computer), or in partnership with players in other cities who form a group of adventurers.

Other PBM games involve writing your moves and actions on turn sheets, then having these sheets "processed" by the computer and the results sent back to you. As a starship commander or warlord of a mercenary army, for example, you may be playing alone against the computer or other players, or as part of a team. Diplomacy —negotiating, influencing, or coercing other players by letter or phone—is often part of PBM games.

Including postage for the turns, letters to the other players, and even telephone calls to other players in the game (not uncommon), a PBM game can run more than $50 a year to play. If you become involved with more than one game, or play in games that have additional costs for special actions, the price to PBM gets quite high.

If you're careful about how many games you enter, cost per year is reasonable—and is far outweighed by the fun. Many of these games are very creative. Even if you can always find friends to game with, a PBM game is well worth trying.

Playing games through the mail is different, unusual, and offers interesting possibilities conventinal games don't offer. You can also meet some interesting people through a PBM game—one couple eventually married.

Not every PBM game may fit your idea of a good game. But with so many different PBM games available, there's bound to be several you'll find challenging and enjoyable, in the list and descriptions that follow in the next issue.

For a free booklet with more information on these PBM games, send your name and address to Dana Lombardy, Analog Science Fiction Magazine, 380 Lexington Ave., New York, NY 10017. ■

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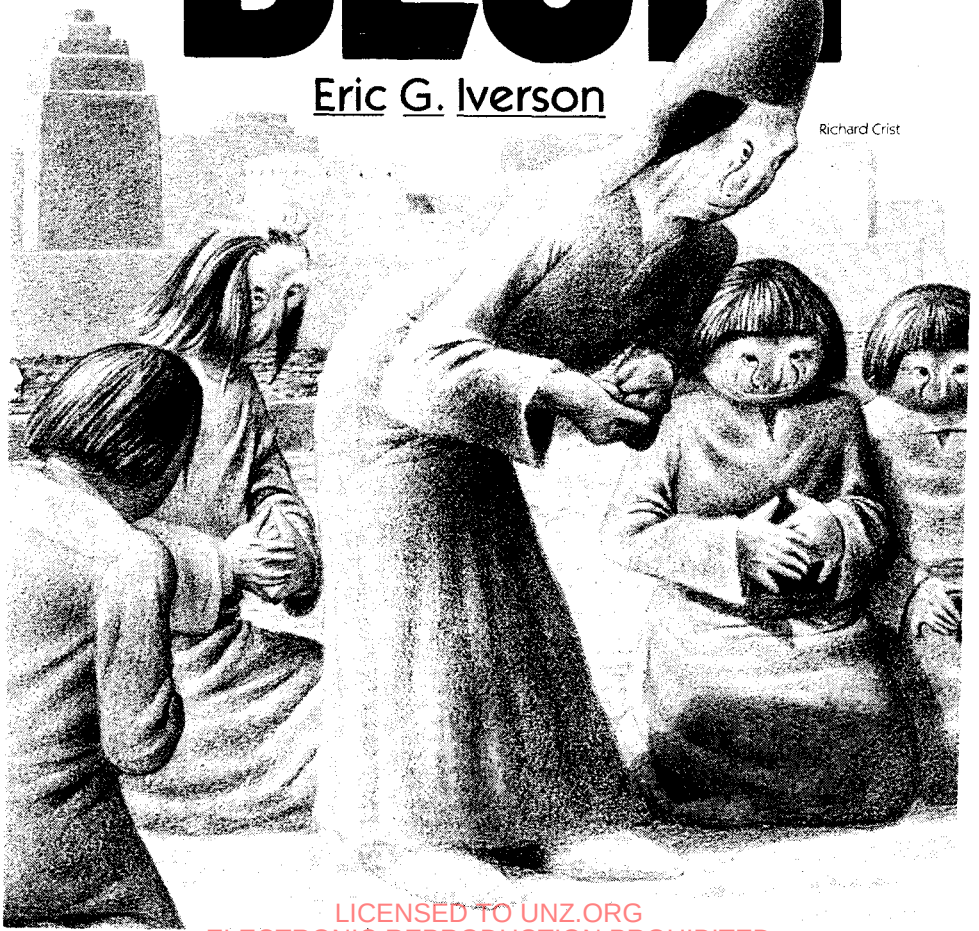
BLUFF

Eric G. Iverson



1

The pictures from the survey satellites came out of the fax machine one after the other, *chunk, chunk, chunk*. Ramon Castillo happened to be close by. He took them from the tray, more out of a sense of duty than in the expectation of finding anything interesting. The previous photo runs of the still-unnamed planet below had proven singularly dull.

There hadn't been a good shot of this river-valley system before, though. As he studied the print, his heavy eyebrows lifted like raven's wings. He felt a flush of excitement beneath his coppery skin, and damned himself for a fool. "Wish-

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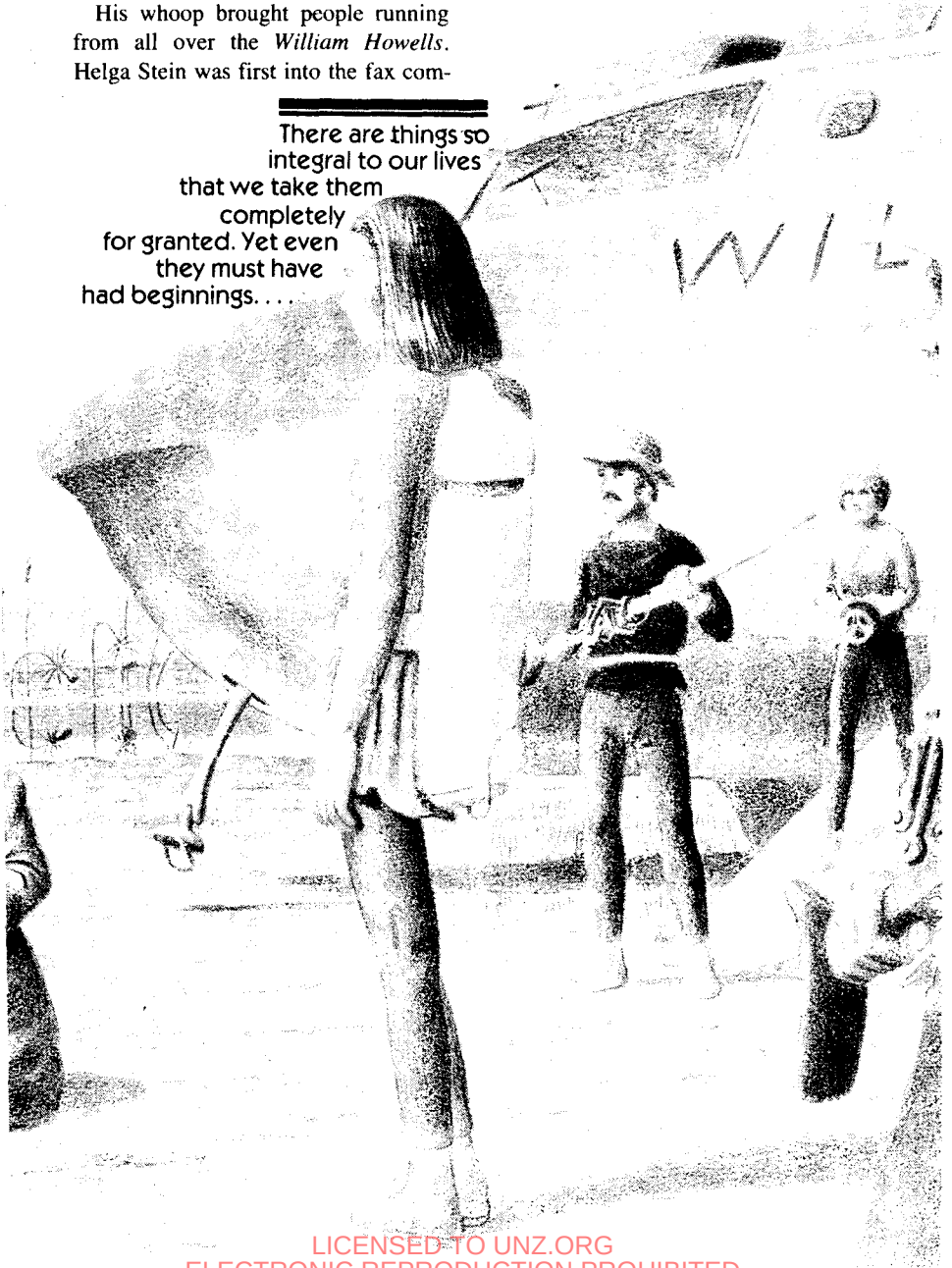
ful thinking," he muttered aloud. Just the same, he slipped the print into the magnifying viewer.

His whoop brought people running from all over the *William Howells*. Helga Stein was first into the fax compartment: a stocky blonde in her late twenties, her normally serious expression now replaced by surprise. "*Mein*

There are things so integral to our lives that we take them completely for granted. Yet even they must have had beginnings. . . .



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Gott, was that you, Ramon?" she exclaimed; Castillo was usually very quiet.

Most of the time he found her intensely annoying; he was a cultural anthropologist and she a psychologist, and their different approaches to problems that touched them both led to frequent arguments. Now, though, he stepped away from the viewer and invited her forward with a courtly sweep of his arm. "You'll see for yourself," he said grandly. He spoke Latin with a facility that left everyone else aboard the *Howells* jealous.

"What am I looking for?" she asked, fiddling with the focus. By then the other members of the survey team were crowding in: physical anthropologist Sybil Hussie and her husband George Davies, who was a biologist (they were married just before upship, and George had endured in good spirits all the stale jokes about practicing what he studied); Xing Mei-lin the linguist; and Manolis Zakythinos, whose specialty was geology.

Even Stan Jeffries stuck his head in to see what the fuss was about. "Found the mountain of solid platinum, did you?" the navigator chuckled, seeing Helga peering into the viewer.

She looked up, puzzlement on her face. "What is that in Latin?" she asked; the ship's English-speakers consistently forgot to use the international scholarly tongue. Grumbling, Jeffries repeated himself.

"Ah," she said, distracted enough to be polite instead of freezing him for his heavyhanded wit. "Interpreting such photos is not my area of expertise, you must understand; I leave that to Sybil or Manolis or Ramon who saw this first. But along the banks of this river there are I think cities set in the midst of a network of canals."

Yells like Castillo's ripped from the entire scientific crew. They all scrambled toward the viewer at the same time. "Ouch!" Sybil Hussie said as an elbow caught her in the ribs. "Have a care, there. This is no bloody rugby scrum —and try doing that into Latin, if anybody has a mind to."

At last, grudgingly, they formed a line. "You see?" Castillo said as they examined the print in turn. He was still voluble in his excitement. "Walled towns with major works of architecture at their centers; outlying hamlets; irrigation works that cover the whole floodplain. Judging by the rest of the planet, I would guess that this is its very first civilization, equivalent to Sumer or Egypt back on Earth."

They had known for several days that the world was inhabited, but nothing at a level higher than tiny farming villages had shown up on any earlier pictures —certainly no culture worth contacting. Now, though—

"A chance to really see how a hydraulic civilization functions, instead of guessing from a random selection of 5,000-year-old finds," Ramon said dreamily.

Mei-lin spoke with down-to-earth practicality. "A chance for a new dissertation." Her Latin was not as fluent as his, but had a precision Caesar might have admired.

"Publications," Helga and George Davies said in the same breath. Everyone laughed.

"Maybe enough art objects to make us all rich," Jeffries put in.

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Manolis Zakythinos made a small, disgusted noise. All the same, the navigator's words hung in the air. It had happened before, to other incoming survey teams. There was always a premium on new forms of beauty.

Zakythinos slipped out. Thinking he was still annoyed, Ramon started to go after him, but the geologist quickly returned with a bottle of ouzo. "To the crows with the vile excuse for vodka the food unit turns out," he cried, his deep-set brown eyes flashing. "This calls for a true celebration."

"Call the captain," someone said as, amid cheers, they repaired to the galley. Most of them stopped at their cabins for something special; Sybil was carrying a squat green bottle of Tanqueray that she put between bourbon and scotch. Odd, Ramon thought, how her husband favored the American drink while Jeffries, who was from the States, preferred scotch.

Castillo's own contribution came from the hills outside his native Bogota. He set the joints, rolled with almost compulsive neatness, beside the liquor. Being moderate by nature, he still had most of the kilo he had brought, and had given away a good deal of what was gone.

Given a choice, he would sooner have drunk beer, but space restrictions aboard the *Howells* made taking it impossible. He sighed and fixed himself a gin and tonic.

He was, inevitably and with inevitable fruitlessness, arguing with Helga about what the aliens below would be like when the buzz of conversation around them quieted for a moment. Blinking, Ramon looked up. Captain Katerina Tolmasova stood in the galley doorway.

Always, Ramon thought, she had that way of drawing attention to herself. Part of it lay in her staying in uniform long after the rest of them had relaxed into jeans or coveralls. But she would have worn her authority like a cloak over any clothes, or none.

In any clothes or none, also, she would have drawn male glances. Not even George Davies was immune, in spite of being a contented newlywed. She was tall, slim, dark: not at all the typical Russian. But her nationality showed in her broad, high cheekbones and in her eyes—enormous blue pools in which a man would gladly drown himself.

It still amazed Ramon, and sometimes frightened him a little, that they shared a bed.

She came over to him, smiling. "I am to understand that we have you to thank for this, ah, occasion?" Her voice made a slow music of Latin. It was the only language they had in common; he wondered how many times in the past thousand years it had been used for love-making.

Now he shrugged. "It could have been anyone. Whoever saw the pictures first would have recognized what was on them."

"I am glad you did, even so. Making contact is ever so much more interesting than weeks in the endless sameness of hyperdrive, though the instructors at the Astrograd Starship Academy would frown to hear me say so." She paused to sip vodka over ice—not the rough ship's brew, but Stolichnaya from her private hoard, which went down like a

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warm whisper—then went on, "Also I am glad we have here beings without a high technology. I shall worry less, of nights." The weapons of the *Howells,* of course, were under her control, along with everything else having to do with the safety of the ship.

"I hope," he said, touching her hand, "that I can help keep you from worrying."

"It is a shame romantic speeches have so little to do with life," she said. She sounded a little sad. Seeing the hurt spring into his eyes, she added quickly, "Not that they are not welcome even so. My quarters would be lonely without you tonight, the more so as afterwards we will be busy, first I guiding the ship down and then you with this new species. We shall not have much time together then; best enjoy while we may."

Pitkhanas, steward-king of the river-god Tabal for the town of Kussara, awoke with the words of the god ringing in his ears: "See to the dredging of the canals today, lest they be filled with silt!"

King though he was, he scrambled from his bed, throwing aside the light, silky coverlet; disobeying the divine voice was unimaginable. He hardly had a backward glance to spare for the superb form of his favorite wife Azzias.

She muttered a drowsy complaint at being disturbed. "I am sorry," he told her. "Tabal has ordered me to see to the dredging of the canals today, lest they be filled with silt."

"Ah," she said, and went back to sleep.

Slaves hurried forward to dress Pitkhanas, draping him in the gold-shot crimson robe of state, setting the conical crown on his head, and slipping his feet into sandals with silver buckles. As he was being clothed, he breakfasted on a small loaf, a leg of boiled fowl from the night before that would not stay fresh much longer, and a pot of fermented fruit juice.

Tabal spoke to him again as he was eating, echoing the previous command. He felt the beginnings of a headache, as always happened when he did not at once do what the god demanded. He hastily finished his food, wiped his mouth on the sleeve of his robe, and hurried out of the royal bedchamber. Servants scrambled to open doors before him.

The last portal swung wide; he strode out of the palace into the central square of Kussara. The morning breeze from the Til-Barsip river was refreshing, drying the sweat that prickled on him under the long robe.

Close by the palace entrance stood the tomb of his father Zidantas, whose skull topped the monument. Several commoners were laying offerings at the front of the tomb: fruits, bread, cheese. In the short skirts of thin stuff that were their sole garments, they were more comfortable than he. When they saw him, they went down on their knees, touching their heads to the ground.

"Praise to your father, my lord king," one of them quavered, his voice muffled. "He has told me where I misplaced a fine alabaster bowl."

"Good for you, then," Pitkhanas said. Dead no less than alive, his father always had a harsh way of speaking to him.

As now: "I thought you were going

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to see to the dredging of the canals today," Zidantas snapped.

"So I am," Pitkhanas said mildly, trying to avoid Zidantas' wrath.

"Then do it," his father growled. The old man had been dead for three years or so. At times his voice and manner were beginning to remind the king of Labarnas, his own grandfather and Zidantas's father. Labarnas rarely spoke from the tomb any more, save to old men and women who remembered him well. Zidantas's presence, though, was as real and pervasive in Kussara as that of Pitkhanas.

Surrounded by his attendants, the king hurried through the town's narrow, winding streets, stepping around or over piles of stinking garbage. The mud-brick housefronts were monotonous, but the two-story buildings provided welcome shade. Despite the breeze, the day was already hot.

Pitkhanas heard people chattering in the courtyards behind the tall blank walls of their homes. A woman's angry screech came from the roof where she and her husband had been sleeping: "Get up, you sot! Are you too sozzled to listen to the gods and work?"

The gods she spoke of were paltry, nattering things, fit for the lower classes: gods of the hearth, of the various crafts, of wayfaring. Pitkhanas had never heard them and did not know all their names; let the priests keep them straight. The great gods of the heavens and earth dealt with him directly, not through such intermediaries.

Kussara's eastern gate was sacred to Ninatta and Kulitta, the god and goddess of the two moons. Their statues stood in a niche above the arch, the stone images fairly bursting with youth. Below them, carts rumbled in and out, their ungreased axles squealing. Sentries paced the wall over the gate. The sun glinted off their bronze spearpoints.

The gate-captain, a scar-seamed veteran named Tushratta, bowed low before Pitkhanas. "How can this one serve you, my lord?"

"Tabal has reminded me that the canals need dredging," the king replied. "Tell some of your soldiers to gather peasants from the fields—three hundred over all will do—and set them to work at it."

"I hear you and obey as I hear and obey the gods," Tushratta said. He touched the alabaster eye-idol that he wore on his belt next to his dagger. They were common all through the Eighteen Cities, as channels to make the voices of the gods easier to understand.

Tushratta bawled the names of several warriors; some came down from the wall, others out of the barracks by the gate. "The canals need dredging," he told them. "Gather peasants from the field—three hundred over all will do—and set them to work at it."

The men dipped their heads, then fanned out into the green fields to do as they had been ordered. The peasants working at their plots knew instinctively what the soldiers were about, and tried to disappear. The warriors routed them out one by one. Soon they gathered the required number, most with hoes or digging-sticks already in their hands.

Pitkhanas gave them their commands, watched them troop off toward the canals in groups of ten or so. They splashed about, deepening the channels so the precious water could flow more

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freely. The king started to go back to the palace to tend to other business, then wondered whether he should stay awhile to encourage the canal-dredgers.

He paused, irresolute, glanced up at the images of the gods for guidance. Kulitta spoke to him: "Best you remain. Seeing the king as well as hearing his words reminds the worker of his purpose."

"Thank you, mistress, for showing me the proper course," Pitkhanas murmured. He went out to the canals to let the peasants see him at close range. His retinue followed, a slave holding a parasol above his head to shield him from the strong sun.

"His majesty is gracious," Tushratta remarked to one of the king's attendants, a plump little man named Radus-piyama, who was priest to the sky-god Tarhund.

The priest clucked reproachfully. "Did you not hear him answer the goddess? Of course he follows her will."

Kulitta's advice had been good; the work went more swiftly than it would have without Pitkhanas' presence. Now and then a man or two would pause to stretch or have a moment's horseplay, splashing muddy water at each other, but they soon returned to their tasks. "The canals need dredging," one reminded himself in stern tones very like the king's.

Because the goddess had told Pitkhanas to stay and oversee the peasants, he was close by when the sky ship descended. The first of it he knew was a low mutter in the air, like distant thunder—but the day was bright and cloudless. Then Radus-piyama cried out and pointed upward. Pitkhanas' gaze followed the priest's finger.

For a moment he did not see what Radus-piyama had spied, but then his eye caught the silver glint of light. It reminded him of the evening star seen at earliest twilight—but only for an instant, for it moved through the heavens like a stooping bird of prey, growing brighter and (he rubbed his eyes) larger. The noise in the sky became a deep roar that smote the ears. Pitkhanas clapped his hands over them. The sound still came through.

"Ninatta, Kulitta, Tarhund lord of the heavens, tell me the meaning of this portent," Pitkhanas exclaimed. The gods were *silent, as if they did not* know. The king waited, more afraid than he had ever been in his life.

If he knew fear, raw panic filled his subjects. The peasants toiling in the canals were screaming and shrieking. Some scrambled onto dry land and fled, while others took deep breaths and ducked under the water to hide from the monstrous heavenly apparition.

Even a few members of Pitkhanas's retinue broke and ran. The soldiers Tushratta had gathered were on the edge of running too, but the gate-captain's angry bellow stopped them: "Hold fast, you cowards! Where are your guts? Stand and protect your king." The command brought most of them back to their places, though a couple kept pelting back toward Kussara.

"Is it a bird, my lord?" Radus-piyama shouted through the thunder. The priest of Tarhund was still at Pitkhanas's side, still pointing to the thing in the sky. It had come close enough to show

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a pair of stubby wings, though those did not flap.

"Say rather a ship," Tushratta told him. Campaigning had, of necessity, made him a keen observer. "Look there: you can see a row of holes along either side, like the oarports of a big river-ship."

"Where are the oars, then?" Radus-piyama asked. Tushratta shrugged, having no more idea than the tubby priest.

"Who would sail a ship through the sky?" Pitkhanas whispered. "The gods?" But they had not spoken to him, nor, as he could see from the fear of the men around him, to anyone else.

The ship, if that was what it was, crushed half a plot of grain beneath it when it touched ground about a hundred paces from the king and his retinue. A gust of warm air blew in their faces. The thunder gradually died. Several of Pitkhanas' attendants—and several of the soldiers—moaned and hid their eyes with their arms, certain their end had come. Had it not been beneath his royal dignity, the king would have done the same.

Tushratta, though, was staring with interest at the marks painted along the sides of the ship below the holes that looked like oarports. "I wonder if that is writing," he said.

"It doesn't look like writing," Radus-piyama protested. All the Eighteen Cities of the Til-Barsip valley used the same script; most of its symbols still bore a strong resemblance to the objects they represented, though rebus-puns and specific grammatical determinants became more subtle and complex generation by generation.

The gate-captain said stubbornly, "There are more ways to write than ours, sir. I've fought against the hill-barbarians, and seen their villages. They use some of our signs for their language, but they have signs of their own, too, ones we don't have in the valley."

"Foreigners," Radus-piyama snorted. "I despise foreigners."

"So do I, but I have had to deal with them," Tushratta said. Foreigners were dangerous. They worshiped gods different from those of the Eighteen Cities, gods who spoke to them in their own unintelligible tongues. And if they spoke with angry voices, war was sure to follow.

A door swung open in the side of the ship. Pitkhanas felt his hearts pounding in his chest; excitement began to replace fear. Perhaps the gods were saying nothing because they were all inside the sky ship, having come to Kussara for some reason of their own. What an honor! Almost everyone heard the gods scores of times each day, but they were rarely seen.

A ramp slid down from the open doorway. The king saw a stir of motion behind it . . . and his hopes of meeting the gods face-to-face were dashed, for the people emerging from the sky ship were the most foreign foreigners he had ever seen.

He wondered if they *were* people. The tallest of them was half a head shorter than the Kussaran average. Instead of blue-gray or green-gray skins, theirs were of earthy shades, rather like dried mud bricks. One was darker than that, and another almost golden. Some had black hair like the folk of the Eighteen Cities and all the other peoples they knew, but the heads of others were

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topped with brownish-yellow or even orange-red locks. One had hair on his face!

Their gear was as unfamiliar as their persons. They wore trousers of some heavy blue fabric, something like those of the hillmen but tight, not baggy. Despite the heat, they were all in tunics, dyed with colors Pitkhanas had never seen on cloth. They held a variety of curious implements.

"Some of those will be warriors," Tushratta said as the royal party drew nearer.

"How can you tell that?" the king asked. To him the square black box one of them was lifting to his face—no, *her* face; by the breasts it was a woman, though what was a woman doing in the company of voyagers?—was as alien as the long, thin contraptions of wood and metal borne by the hairy-faced stranger and a couple of others.

"The way they carry them, my lord," the gate-captain answered, pointing to the trio with the long things. "And the way they watch us—they have something of the soldier to them."

Once it was pointed out to him, Pitkhanas could also see what Tushratta had noticed. He would never have spotted it for himself, though. "How can you observe so clearly, with the voices of the god mute?" he said. That awful silence inside his head left him bewildered.

Tushratta shrugged. "I have seen soldiers among us and among the barbarians in the hills, my lord. My eyes tell me how these men are like them. Were the gods speaking, they would say the same, surely."

The golden-skinned stranger, the smallest of them all, descended from the ramp of the sky ship and slowly approached Pitkhanas and his followers. He held his hands out before him. The gesture was plainly peaceful, but not fully reassuring to the king: the foreigners, he saw, had only one thumb on each hand.

A moment later, the breath hissed from his nostrils in anger. "They insult me—it is a woman they send as herald!" This foreigner was so slimly made that only up close did the difference become apparent.

Hearing Pitkhanas' exclamation, one of the soldiers stepped forward to seize the offender. But before he could lay hands on her, she touched a button on her belt and shot into the air, hovering overhead at five times the height of a man.

The soldier, the attendants, the king gaped in astonishment. The sky ship was entirely outside their experience, too alien for them to gauge the power it represented. This, though—"Do not try to injure them again, or they will destroy us all!" Zidantas shouted to Pitkhanas.

"Of course, sire," the king gasped, putting his palms to his temples in relief that his dead father's voice had returned to him. "Do not try to injure them again, or they will destroy us all!" he called to his men, adding, "Abase yourselves, so they can see your repentance."

Heedless of their robes and skirts, his followers went to their knees in the soft mud of the field. Pitkhanas himself bowed from the waist, holding his eyes to the ground.

One of the strangers on the ramp of

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the sky ship called out something. His voice sounded like any other man's, but the words were meaningless to the king.

A soft touch on his shoulder made him look up. The foreign woman was standing before him, her feet touching the ground once more. She gestured that he should straighten himself. When he had, she bowed in return, as deeply as he had. She pointed to his men and motioned for them to rise too.

"Stand up," he told them.

As they were doing so, the woman went to her knees in the mud herself, careless of her rich, strange clothing. She got up quickly, echoing Pitkhanas's command with a questioning note in her voice.

He corrected her, using the singular verb-form this time instead of the plural. She understood at once, pointing to one man and repeating the singular and then at several and using the plural. He smiled, dipped his head, and spread his arms wide to show that she was right.

It began there.

"May I speak with you, my lord?" Radus-piyama asked.

"Yes," Pitkhanas said, a little wearily. He could feel in his belly what was about to come from the priest. Radus-piyama had been saying the same thing for many days now.

Nor did he surprise the king; with more passion than one would have expected to find in his small, round frame, he burst out, "My lord, I ask you again to expel the dirt-colored foreigners from Kussara. Tarhund has spoken to me once more, urging me to set this task upon you, lest they corrupt Kussara and all the Eighteen Cities."

"The god has given me no such command," Pitkhanas replied, as he had all the previous times Radus-piyama had asked him to get rid of the strangers. "If I hear it from his lips, be sure I shall obey. But until then these people from the far land called Terra are welcome here. They bring many fine gifts and things to trade." His hand went to his belt. The knife that hung there was a present from the Terrajin; it was made from a gray metal that was stronger than the best bronze and held a better edge.

"Come with me to the temple, then," Radus-piyama said. "Perhaps in his own home you will know the god's will more clearly."

Pitkhanas hesitated. Tarhund spoke to him: "Go with my priest to my house in Kussara. If I have further commands for you, you should best hear them there."

"The god bids me go with you to his house in Kussara," the king told Radus-piyama. "If he has further commands for me, I should best hear them there."

Radus-piyama showed his teeth in a delighted grin. "Splendid, my lord! Surely Tarhund will show you the proper course. I had begun to fear that you no longer heard the gods at all, that you had become as deaf to them as the Terrajin are."

Pitkhanas made an angry noise in the back of his throat. "Not agreeing with you, priest, does not leave one accursed. Tushratta, for instance, prospers, yet he is most intimate with the Terrajin of anyone in Kussara."

Radus-piyama had begun to cringe in the face of the king's temper, but at mention of the officer he recovered and gave a contemptuous sneer. "Choose

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someone else as an example, my lord, not Tushratta. The gods have gradually been forgetting him for years. Why, he told me once that without his eye-idol he rarely hears them. Aye, he is a fit one to associate with the foreigners. He even has to cast the bones to learn what course he should take."

"Well, so do we all, now and then," the king reproved. "They show us the will of the gods."

"Oh, no doubt, my lord," Radus-piyama said. "But no one I know of has to use the bones as often as Tushratta. If the gods spoke to him more, he would have fewer occasions to call on such less certain ways of learning what they wanted of him."

"He is a good soldier," Pitkhanas said stiffly. Radus-piyama, seeing that he could not sway the king on this question, bowed his head in acquiescence. "To the temple, then," Pitkhanas said.

As usual near midday, the central square of Kussara was jammed with people. Potters and smiths traded their wares for grain or beer. Rug-makers displayed their colorful products in the hope of attracting customers wealthy enough to afford them. "Clear, fresh river-water!" a hawker called. "No need to drink it muddy from the canal!" He had two large clay jugs slung over his shoulder on a carrying-pole. Harlots swayed boldly through the crowd. Slaves followed them with their eyes or dozed in whatever shade they could find. More gathered at a small shrine, offering a handful of meal or fruit to its god in exchange for advice.

Pitkhanas also saw a couple of Terrajin in the square. The foreigners still drew stares from peasants new in town and attracted small groups of curious children wherever they went, but most of Kussara had grown used to them in the past year-quarter. Their odd clothes and coloring, the metal boxes they carried that clicked or hummed, were accepted peculiarities now, like the feather-decked turbans of the men from the city of Hurma or the habit the people of the town of Yuzat had of spitting after every sentence.

The Terraj called Kastiyo was haggling with a carpenter over the price of a stool as the king and Radus-piyama came by. "I know wood is valuable because you have to trade to get it," the Terraj was saying, "but surely this silver ring is a good payment." Kastiyo fumbled for words and spoke slowly, but he made himself understood; after tiny Jingmaylin, he probably had the best grasp of Kussara's language.

The carpenter weighed the ring in his hand. "Is it enough?"

"Who—ah, whom—do you ask?" the Terraj said.

"Why, my god, of course: Kadashman, patron of woodworkers. He says the bargain is fair." The carpenter lifted the stool, gave it to Kastiyo, and held out his hand for the ring.

The foreigner passed it to him, but persisted, "How is it you know what the god says?"

"I hear him, naturally, just as I hear you; but you will go away and he is always with me." The carpenter looked as confused as the Terraj. Then he brightened. "Perhaps you do not know Kadashman because you are not a woodworker and he has no cause to speak to you. But surely your own gods talk to you in much the same way."

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"I have never heard a god," Kastiyo said soberly. "None of my people has. That is why we is—*are*—so interested in learning more about those of Kussara."

The carpenter's jaw dropped at Kastiyo's admission. "You see?" Radus-piyama said to Pitkhanas. "Out of their own mouths comes proof of their accursedness."

"They have gods, or a god," the king answered. "I have asked them that."

Radus-piyama laughed. "How could there be only one god? And even if there were, would he not speak to his people?"

To that Pitkhanas had no reply. He and the priest walked in silence to the temple of Tarhund, the Great House, as it was called: after the shrine of Tabal, the tallest and most splendid building in Kussara. The temples towered over the palace of the steward-king, who was merely the gods' servant. The huge rectangular tower of mud-brick rose in ever smaller stages to Tarhund's chamber at the very top.

Together, Pitkhanas and Radus-piyama climbed the temple's 316 steps —one for each day of the year. Underpriests bowed to their chief and to the king, who could see the surprise on their faces at his unscheduled visit.

"Is the god properly robed?" Radus-piyama called when they were nearly at the top.

The door to Tarhund's chambers swung open. A priest whose skin was gray with age emerged, his walk a slow hobble helped by a stick. "That he is, sir," he replied, "and pronounces himself greatly pleased with his new vestments, too."

"Excellent, Millawanda," Radus-piyama said. "Then he will give our king good advice about the Terrajin."

Millawanda's eyesight was beginning to fail, and he had not noticed Pitkhanas standing beside Radus-piyama. The king waved for him not to bother when he started a shaky bow. "Thank you, my lord. Yes, Tarhund has mentioned the foreigners to me. He says—"

"I will hear for myself what he says, thank you," Pitkhanas said. He stepped toward the god's chambers. When Radus-piyama started to follow him, he waved him back; he was still annoyed that the priest had feared Tarhund was not speaking to him any more.

Tarhund stood in his niche, an awesome figure, taller than a man. Torchlight played off the gold leaf that covered his face, hands, and feet, and off the gold and silver threads running through the thick, rich cloth of his new ankle-length robe. In his left hand he held the solid-gold globe of the sun, in his right black stormclouds.

The king suddenly saw with horror that he had forgotten to bring any offering when the god summoned him. He groveled on his belly before Tarhund as the lowliest of his slaves would have before him. Stripping off his sandals with their silver buckles, he set them on the table in front of the god next to the gifts of food, beer, and incense from the priests. "Accept these from this worm, your servant," he implored.

Tarhund's enormous eyes of polished jet gripped and held him. The god's words echoed in Pitkhanas' ears: "You may speak."

"Thank you, my master." Still on the floor, the king poured out everything

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that had happened since the coming of the Terrajin. "Are they stronger than you, lord, and your brother and sister gods? When we first met them, their powers and strangeness silenced your voices, and we despaired. You returned as we grew to know them, but now you speak in one way to your priests and in another to me. What shall I do? Shall I destroy the Terrajin, or order them to leave? Or shall I let them go on as they would, seeing that they have done no harm yet? Say on; let me know your will."

The god took so long answering that Pitkhanas trembled and felt his limbs grow weak with fear. If the strangers *were* mightier than the gods—But at last Tarhund replied, though his voice seemed faint and far away, almost a divine mumble: "Let them go on as they would. Seeing that they have done no harm yet, they will keep on behaving well."

Pitkhanas knocked his forehead against mud brick. "I hear and obey, my master." He dared another question: "My lord, how is it that the Terrajin hear no gods of their own?"

Tarhund spoke again, but only in a gabble from which the king could understand nothing. Tears filled his eyes. He asked, "Is it as Radus-piyama says, that they are accursed?"

"No." This time the god's answer came quick, clear, and sharp. "Accursed men would work evil. They do not. Tell Radus-piyama to judge them by their deeds."

"Aye, my master." Sensing that the divine audience was over, Pitkhanas rose and left Tarhund's chamber. Radus-piyama and Millawanda were waiting expectantly outside. The king said, "The god has declared to me that the Terrajin are not accursed. Accursed men would work evil. They do not, and they will keep on behaving well. Judge them by their deeds. This is Tarhund's command to me, and mine to you. Hear it always."

The priests blinked in surprise. But their obedience to the king was as ingrained as their service to Tarhund. "I hear you and obey as I hear and obey *the god*," Radus-piyama acknowledged, Millawanda following him a moment later.

Satisfied, Pitkhanas started down the long stairway of Tarhund's Great House. Had he conveyed his orders in writing, the priests might somehow have found a way to bend them to their own desires. Now, though, his wishes and Tarhund's would both be ringing in their ears. They would give him no more trouble over the Terrajin.

The tape of Ramon Castillo dickering with the Kussaran woodworker ended. The video screen went dark. Helga Stein lifted her headphones, rubbed her ears. "Another one," she sighed.

"What was that?" Castillo was still wearing his 'phones, which muffled her words. "Sorry." He took them off quickly.

"It's nothing," Helga said wearily. She turned to Mei-lin, who had been going over the tape with them. "Did I understand that correctly—the native calling on a deity named Kadashman at the decision-point?"

"Oh yes," the linguist answered at once. To Ramon she added, "You do

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very well with the language. He had no trouble following you at all."

"Thanks," he said; Mei-lin was not one to give praise lightly. But he had to object, " 'Calling on' isn't quite what happened. He asked a question, got an answer, and acted on it. Look for yourselves."

When he reached to rewind the tape, Helga stopped him. "Don't bother; all of us have seen the like dozens of times already. The local's eyes get far away for a few seconds, or however long it takes, then he comes out of it and does whatever he does. But what does it *mean?*"

" 'Eyes get far away,' " Ramon said. "That's not a bad way to put it, I suppose, but to me it just looks as though the natives are listening."

"To what?" Helga flared, her face going pink. "And if you say 'a god,' I'll brain you with this table."

"It's bolted to the floor," he pointed out.

"Ach!" She snarled a guttural oath that was emphatically not Latin, stormed out of the workroom.

"You should not tease her so, Ramon," Mei-lin said quietly. Trouble rested on her usually calm features.

"I didn't mean to," the cultural anthropologist replied, still taken aback at Helga's outburst. "I simply have a very literal mind. I was going to suggest that if she had to hit me, the stool I bought would serve better."

Mei-lin smiled a dutiful smile. "At least you and Sybil have your stools and other artifacts you can put your hands on to study. All Helga and I can do is examine patterns, and none of the patterns here makes any sense that I can find."

"You shouldn't expect an alien species to think as we do."

"Spare me the tautology," the linguist snapped; her small sarcasm shocked Castillo much more than Helga's losing her temper. "For that matter, I sometimes wonder if these Kussarans think at all."

Ramon was shocked again, for she plainly meant it. "What about this, then?" he said, holding up the stool. It was a fine piece of craftsmanship, the legs beautifully fitted to the seat, the dyed-leather seatcover secured by bronze tacks to the wood below. "What about their walls and temples and houses, their cloth, their fields and canals, their writing, their language?"

"What about their language?" she retorted. "As I said, you've learned it quite well. You tell me how to say "to think' in Kussaran."

"Why, it's—" Castillo began, and then stopped, his mouth hanging open. *"No sé,"* he admitted, startled back into Spanish, a slip he rarely made.

"I don't know either, or how to say 'to wonder' or 'to doubt' or 'to believe' or any other word that relates to cognition. And any Kussaran who says, "I feel it in my bones' suffers from arthritis. Your 'literal mind' would make you a wildeyed dreamer among these people, Ramon. How can they live without reflecting on life? Is it any wonder that Helga and I feel we're eating soup with a fork?"

"No-o," he said slowly. Then he laughed. "Maybe their precious gods do their thinking for them." The laugh was not one of amusement. The problem

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of the gods vexed him as much as it did Helga. Where she fretted over failing to understand the locals' psychological makeup, he had the feeling he was seeing their cultural patterns only through fog—superficial shapes were clear, but whatever was behind them was hidden in the mist.

Mei-lin failed to find his suggestion even sardonically amusing. "There are no gods. If there were, our instruments would have detected them."

"Telepathy?" Ramon probed, hoping to get a rise out of her.

She did not take the bait. All she said was, "Assuming it exists (which I don't), telepathy from whom? The bugs we've scattered around show that the king, the ministers, the priests talk to their gods as often as the peasants do—oftener, if anything. There are no secret rulers, Ramon."

"I know." His shoulders sagged a little. "In fact, the Kussarans who hold the fewest one-sided conversations are some of the soldiers and merchants—and everyone else looks down on them on account of it."

"Still, if they were all as interested in us as Tushratta, our job would be ten times easier."

"True enough." The gate-captain spent as much of his time at the *Howells* as his duties allowed. "I wouldn't be surprised if he's around so much because we have no gods at all and give him someone to feel superior to."

"You're getting as cynical as Stan Jeffries," she said, which canceled his pleasure at her earlier compliment. Feeling his face grow hot, he rose and took a hasty leave.

As he passed the galley, he thought there was some god working, and probably a malignant one, for Jeffries himself called, "Hey, Ramon, come sit in for a while. Reiko's engine-watch just started, and we're short-handed."

The inevitable poker game had begun when the *Howells* was still in parking orbit around Terra. Castillo rarely played. Not only were the regulars some of his least favorite people on the ship, they also won money from him with great regularity.

He was about to decline again when he saw Tushratta was one of the players. The Kussarans gambled among themselves with dice, and the soldier was evidently picking up a new game. He looked rather uncomfortable in a Terran chair: it was too small for him and did not quite suit his proportions.

"What does he use to buy chips?" Ramon asked, sitting down across from the native.

João Gomes, one of the engine-room technicians, said a little too quickly, "Oh, we give them to him. He just plays for fun."

Castillo raised an eyebrow. The technician flushed. Jeffries said, "Why fight it, João? He can always ask Tushratta himself. All right, Ramon, he buys in with native goods: pots and bracelets and such. When he wins, we pay off with our own trinkets: a pair of scissors, a pocketknife, a flashlight." He stared defiantly at the anthropologist. "Want to make something of it?"

That sort of dealing was technically against regulations, but Ramon said, "I suppose not, provided I get photos of all the Kussaran artifacts you've gotten from him."

"Naturally," Jeffries agreed. Faces

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fell all around the table. Castillo hid a smile. Of course the poker players had been planning to hide the small trinkets and sell them for their own profit when they got home. It happened on every expedition that found intelligent natives, one way or another. The anthropologist was also certain he would not see everything.

Tushratta pointed at the deck of cards. "Deal," he said in heavily accented but understandable Latin.

To keep things simple for the beginner, they stuck with five-card stud and one joker. "A good skill game, anyway," Jeffries said. "You can tell where you stand. You play something like seven stud, low in the hole wild, and you don't know whether to shit or go blind."

Ramon lost a little, won a little, lost a little more. He might have done better if he hadn't been paying as much attention to Tushratta as to the cards—or, he told himself with characteristic honesty, he might not. As was to be expected among more experienced players, the native lost, but not too badly. His worst flaw, Castillo thought, was a tendency not to test bluffs: a problem the anthropologist had himself.

When Tushratta ran low on chips, he dug in his pouch and produced a cylinder seal, a beautifully carved piece of alabaster about the size of his little finger designed to be rolled on a mud tablet to show that he had written it. The stake Gomes gave him for it seemed honest.

A couple of hands later, the Kussaran and Jeffries got into an expensive one. Ramon was dealing, but folded after his third card. Everyone else dropped out on the next one, with varied mutters of disgust.

"Last card," the anthropologist said. He tossed them out.

Someone gave a low whistle. Jeffries, grinning, had four diamonds up. A couple of chairs away, Tushratta was sitting behind two pairs: treys and nines.

"Your bet, Tushratta," Ramon said. The Kussaran did, heavily.

"Ah, now we separate the sheep from the goats," Jeffries said, and raised. But the navigator's grin slipped when Tushratta raised back. "Oh, you bastard," he said in English. He shoved in more chips. "Call."

Looking smug, Tushratta showed his hole card: a third nine. "Ouch," Jeffries said. "No wonder you bumped it up, with a full house." Castillo was not sure how much of that Tushratta understood, but the Kussaran knew he had won. He raked in the pot with both hands, started stacking the chips in neat piles of five in front of him.

Jeffries managed a sour grin. "Not that you needed the boat," he said to Tushratta. He turned over his own fifth card. It was a club.

Laughter erupted around the table. "That'll teach you, Stan," Gomes said. "Serves you right."

Tushratta knocked several piles of chips onto the floor. He made no move to pick them up; he was staring at Jeffries's hole card as though he did not believe his eyes. "You had nothing," he said.

The navigator had learned enough Kussaran to follow him. "A pair of sixes, actually."

Tushratta waved that away, as of no importance. He spoke slowly, sound-

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ing, Ramon thought, uncertain where his words were leading him: "You saw my two pairs showing. You could not beat them, but you kept betting. Why did you do that?"

"It was a bluff that didn't work," Jeffries answered. The key word came out in Latin. He turned to Castillo for help. "Explain it to him, Ramon; you're smoother with the lingo than I am."

"I'll try," the anthropologist said; he did not know the word for "bluff" either. Circumlocution, then: "You saw Jeffries' four diamonds. He wanted to make you drop by acting as though he had a flush. He did not know you had three nines. If you only had the two pairs that were up, you would lose against a flush, and so you might not bet against it. That was what he wanted—that is what bluff is."

"But he did not have a flush," Tushratta protested, almost in a wail.

"But he seemed to, did he not? Tell me, if you had only had the two pair, what would you have done when he raised?"

Tushratta pressed the heels of his hands against his eyes. He was silent for almost a full minute. At last he said, very low, "I would have folded."

Then he did retrieve the chips he had spilled, carefully restacked them. "I have had enough poker for today. What will you give me for these? There are many more here than I had yesterday."

They settled on a hand-held mirror, three butane lighters, and a hatchet. Ramon suspected the latter would be used on skulls, not timber. For the moment, though, Tushratta was anything but warlike. Still in the brown study that had gripped him since he won the hand from Jeffries, he took up his loot and left, talking to himself.

Castillo did not think he was communing with his mysterious gods; it sounded more like an internal argument. "But he didn't . . . But he seemed to . . . But he didn't . . . Bluff . . . "

"What's all that about?" Jeffries asked.

When the anthropologist translated, Gomes chuckled. "There you go, Stan, corrupting the natives." The navigator threw a chip at him.

"I laughed with the rest of them," Castillo said as he recounted the poker game in his cabin that night, "but looking back, I'm not sure João wasn't absolutely right. Katerina, I'd swear the idea of deceit had never crossed Tushratta's mind."

Frowning, the captain sat up in bed, her hair spilling softly over her bare shoulders. Her specialty was far removed from Ramon's, but she brought an incisive, highly logical mind to bear on any problem she faced. "Perhaps he was merely taken aback by a facet of the game that he had not thought of before."

"It went deeper than that," the anthropologist insisted. "He had to have the whole notion of bluffing defined for him, and it hit him hard. And as for thinking, Mei-lin has me wondering if the Kussarans really do."

"Really do what? Think? Don't be absurd, Ramon; of course they do. How could they have built this civilization of theirs without thinking?"

Castillo smiled. "Exactly what I said this afternoon." He repeated Mei-lin's argument for Katerina, finished, "As

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far as I can see, she has a point. Concepts can't exist in a culture without words to express them."

"Just so," the captain agreed. "As Marx said, it is not the consciousness of men that determines their existence, but rather their social existence deterines their consciousness."

You and your Marx, Castillo thought fondly. He did not say that aloud, any more than he would have challenged Manolis Zakythinos's Orthodox Christianity. What he did say was, "Here's Kussara in front of us as evidence to the contrary."

"Only because we do not understand it," Katerina said firmly, her secular faith unshakable.

Still, Ramon could not deny the truth in her words, and admitted as much. "Their gods, for instance. We may not be able to see or hear them, but they're real as mud brick to the Kussarans."

"All primitive peoples talk to their gods," Katerina said.

"But not all of them have gods who answer back," the anthropologist replied, "and the locals certainly listen to theirs. In fact, they—"

His voice trailed away as his mind began working furiously. Suddenly he leaned over and kissed Katerina with a fervor that had nothing to do with lovemaking. He sprang out of bed, hurrying over to the computer terminal at his desk. Katerina exclaimed in surprise and a little indignation. He paid no attention, which was a measure of his excitement.

It took him a while to find the database he needed; it was not one he used often. When at last he did, he could hardly kee his fingers from trembling as he punched in his search commands. He felt like shouting when the readout began flowing across the screen.

Instead, he whispered, "I know. I know."

"You're crazy," Helga Stein said flatly when Ramon finished his presentation at a hastily called meeting the next morning. It was, he thought with a giddiness brought on by lack of sleep, a hell of a thing for a psychologist to say, but then Latin was a blunt language. And glances round the table showed that most of their colleagues agreed with her. Only Mei-lin seemed to be withholding judgment.

"Argue with the evidence, not with me," he said. "As far as I can see, it all points toward the conclusion I've outlined: the Kussarans are not conscious beings."

"Oh, piffle, Ramon," Sybil Hussie said. "My old cat Bill back in Manchester is a conscious being."

Castillo wished he was someplace else; he was too shy to enjoy putting forth a strange idea to a hostile audience. But he was also too stubborn to fold up in the face of mockery. "No, Sybil," he said, "your old Bill, that mangy creature—I've met him, you know—isn't conscious, he's simply aware."

"Well, what is the difference?" Manolis Zakythinos asked.

"Or, better, how do you define consciousness?" George Davies put in.

"With Helga over there waiting to pounce on me, I won't even try. Let her do it."

The psychologist blinked when Ramon tossed the ball to her, rather like

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a prosecution witness unexpectedly summoned by the defense. Her answer came slowly: "Consciousness is an action, not an essence. It manipulates meanings in a metaphorical space in a way analogous to manipulating real objects in real space. In 'meanings' I include the mental image a conscious being holds of itself. Consciousness operates on whatever the conscious being is thinking about, choosing relevant elements and building patterns from them as experience has taught it. I must agree with Ramon, Sybil: your cat is not a conscious being. It is aware, but it is not aware of itself being aware. If you want a short definition, that is what consciousness is."

Davies was already sputtering protests. "It's bloody incomplete, is what it is. What about thinking? What about learning?"

Reluctantly, Helga said, "One does not have to be conscious to think." That turned a storm of protest against her that dwarfed anything Ramon had faced. She waited for it to end. "I will show you, then. Give me the next number in this sequence: one, four, seven, ten—"

"Thirteen." The response came instantly, from three or four people at once.

"How did you know that?" she asked them. "Were you aware of yourselves reasoning that you had to add three to the last number and then carrying out the addition? Or did you simply recognize the pattern and see what the next element *had* to be? From the speed with which you answered, I'd guess the latter—and where is the conscious thought there?"

Abrupt silence fell round the conference table. It was, Ramon thought, an introspective sort of silence: the very stuff of consciousness.

George Davies broke it. "You picked too simple an example, Helga. Give us something more complicated."

"What about typing, then, or playing a synthesizer? In both of them, the only way to perform well is to suppress your consciousness. The moment you start thinking about what you are doing, instead of doing it, you will go wrong."

That—thoughtful—silence descended once more. When Helga spoke again, she looked first toward Castillo, grudging respect in her eyes. "You've convinced me of the possibility, at least, Ramon, or rather made me convince myself."

"I like it," Mei-lin said with sudden decision. "It fits. The total lack of mental imagery in the Kussaran language has been obvious to me for weeks. If the Kussarans are not conscious, they have no need for it."

"How do they get along without consciousness?" Davies challenged. "How can they function?"

"You do yourself, all the time," Ramon said. Before the biologist could object, he went on, "Think of a time when you were walking somewhere deep in a conversation with someone. Haven't you ever looked up and said, 'Oh, we're here,' with no memory of having crossed a street or two or gone by a park? Your consciousness was busy elsewhere, and the rest of your intelligence coped for you. Take away the part that was talking with your friend and you have what the Kussarans are like all the time. They get along just fine on pattern recognition and habit."

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"And what happens when those aren't enough?" Davies asked, stabbing out a triumphant finger. "What happens when a Kussaran turns his old familiar corner and the smithy's caught fire and the whole street is burning? What then?"

Castillo licked his lips. He wished the question had not come so soon, or so bluntly. No help for it now, though. He took a deep breath and answered, "Then his gods tell him what to do."

He had not known so few people could make so much noise. For a moment he actually wondered if the attack was going to be physical; George Davies and his wife bounced halfway out of their chairs as they showered him with abuse. So did Helga, who shouted, "I was right the first time, Ramon—you *are* crazy." Even Mei-lin was shaking her head.

"Shouldn't you hear me out before you lock me up?" Castillo said tightly, almost shaking with anger.

"Why listen to more drivel?" Sybil Hussie said with a toss of her head.

"No, he is right," Zakythinos said. "Let him back up his claim, if he can. If he can convince such an, ah, skeptical audience, he deserves to be taken seriously."

"Thank you, Manolis." Ramon had himself under tight control again; railing back at them would not help. "Let me start out by saying that what I'm proposing isn't new; the idea was first put forward by Jaynes over a hundred and fifty years ago, back in the 1970's, for ancient Terran civilizations."

Helga rolled her eyes. "*Ach,* that period. Gods from outer space, is it?"

"Nothing like that," Castillo said, adding with some relish, "Jaynes was a psychologist, as a matter of fact."

"And what sort of gods, if I may make so bold as to ask, would a psychologist have?" Sybil said in a tone calculated to put Helga's teeth on edge as well as Ramon's.

The cultural anthropologist, though, had his answer ready: "Auditory and sometimes visual hallucinations, generated by the right side of the brain—the part that deals with patterns and broad perceptions rather than logic and speech. They would not be recognized as hallucinations, you understand; they would be perceived as divine voices. And, operating with the stored-up experience of a person's life, they would find the behavior pattern that fit any new or unexpected situation, and tell him what to do. No conscious thought would be involved at all."

"It is drivel—" Sybil bgan, but her husband was shaking his head.

"I wonder," he said slowly. "Kussaran life is organized neurologically on the same general pattern as Terran; dissection of native corpses and work with domestic animals clearly shows that. There are differences, of course—brain functions, for instance, seem to be arranged fore-and-aft, rather than axially as with us."

"That's your province, of course," Ramon said. If George was arguing on those terms, he had to be considering the idea.

"These 'divine voices,' " Helga said. "They would be related to the voices schizophrenics hear?"

"Very closely," Castillo agreed. "But they would be normal and universal, not something to be resisted and feared by

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the vestiges of the conscious mind-pattern. And the threshold for producing them would be much lower than it is in schizophrenics—anything unusual or unfamiliar would touch them off. So could the sight of an idol; that may be why Kussara is so littered with them."

Davies sat straighter in his chair, a mannerism he had when he was coming up with an objection he thought telling. "What possible evolutionary advantage could there be to a way of life based on hallucination?"

"Social control," Ramon answered. "Remember, these aren't conscious beings we're talking about. They cannot visualize a connected series of activities, as we do. The only way for one of them weeding a field, say, to keep at his job all day long without someone standing over him, would be to keep hearing the voice of a chief or king saying over and over, 'Pull them out!' "

"Hmm," was all the biologist said.

"And since the king is part of the system too," Helga mused, "he would hear the voices of whatever high gods his culture had. They would be the only ones with enough authority to direct him."

"Perhaps of his ancestors also," Ramon said. "Remember that shrine by Pitkhanas' palace—it's a monument to his father, the last king of the city. There are offerings there, as to the gods."

"So there are." The psychologist paused, her eyes going big and round. "*Lieber Gott!* For such beings, belief in an afterlife would come naturally, and with reason. If a woman still heard, for instance, her mother's voice after her mother had died, would her mother not still be alive for her, in a very real sense of the word?"

"I hadn't even thought of that," Ramon whispered.

George Davies remained unconvinced. "If this style of perception is so wonderful, why aren't we all still blissfully unconscious?"

Castillo gave credit where it was due. "A remark of Katerina's put me on this track. Work it through. As a society gets increasingly complex, more and more layers of gods get added, to take care of all social levels. Look at Kussara now, with a separate deity for the carpenters and one for every other trade. Eventually, the system breaks down under its own weight.

"Writing helps, too. Writing makes a more complicated society possible, but it also weakens the authority of hallucinations. It's easier to evade a command when it's on a tablet in front of you that can be thrown away than when the king's voice sounds in your ear.

"And finally, the structure is geared to stability. It would have to come apart during war and crisis. What good are the commands of your gods if you're dealing with someone from a different culture, with a different language and strange gods of his own? Their orders would be as likely to get you killed as to save you.

"And in noticing how oddly the foreigners acted, you might account for it through something different inside them. And once you conceived of strangers with interior selves, you might suppose you had one too: the beginning of consciousness itself, maybe."

"There is evidence for that," Mei-lin broke in excitedly. "Remember, Ra-

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mon, how you remarked that the Kussarans who talked least with their gods were warriors and traders? They are exactly the ones with the greatest contact with foreigners—they may be on the very edge of becoming conscious beings."

All the anthropologist could do was nod. He felt dazed; the others were running with his hypothesis now in ways he had not imagined. And that, he thought, was as it should be. The concept was too big for any one man to claim it all.

Still sounding sour, George said, "I suppose we can work up experiments to test all this, if it's there." That was fitting too. If the idea had merit, it would come through inquiry unscathed or, better, refined and improved. If not, it did not deserve to survive.

Ramon could hardly wait to find out.

Holding his hands to his ears against the thunder, Pitkhanas watched the sky ship shrink as it rose into the heavens. It was the size of his fist at arm's length . . . the size of a night-flitterer . . . a point of silver light . . . gone.

The king saw how the great weight of the ship had pressed the ground where it had rested down half a forearm's depth. The grain that had been under it, of course, was long dead; the fields around the spot were rank and untended.

The fertility-goddess Yarris addressed Pitkhanas reproachfully. "That is good cropland. Set peasants to restoring its former lushness."

"It shall be done, mistress," he murmured, and relayed the command to his ministers.

His dead father spoke up. "Have warriors out to guard the peasants, to keep the men of Maruwas down the river from raiding as they did when you were a boy. See you to it."

Pitkhanas turned to Tushratta. "Zidantas warns me to have warriors out to guard the peasants, to keep the men of Maruwas down the river from raiding as they did when I was a boy. See you to it."

Tushratta bowed. "I hear you and obey as I hear and obey the gods." The king walked off, never doubting his order would be obeyed.

In fact Tushratta did not hear the gods at all any more. Their voices had been slowly fading in his ears since his campaigns against the hillmen, but he knew to the day when they had vanished for good. "*Bluff,*" he said under his breath. He used the Terraj word; there was nothing like it in Kussaran.

He missed the gods terribly. He had even beseeched them to return—and how strange a thing was that, for the gods should always be present! Without their counsel, he felt naked and empty in the world.

But he went on. Indeed, he prospered. Perhaps the gods still listened to him, even if they would not speak. In the half-year since they left him, he had risen from gate-captain to warmaster of Kussara—the previous holder of that office having suddenly died. With himself he had brought certain other officers—young men who looked to him for guidance—and the detachments that obeyed them.

He would, he decided, follow Pitkhanas's command after all—but in his own fashion. As leader of the soldiers in the fields he would pick, hmm, Ku-

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shukh, who was not loyal to him . . . but who did head the palace guards.

How to get Kushukh to leave his post? "*Bluff*," Tushratta muttered again. He still used the concept haltingly, like a man trying to speak a foreign language he did not know well. Standing as it were to one side of himself, seeing himself saying or doing one thing but intending another, took an effort that made sweat spring out on his forehead.

He would say . . . would say . . . His fist clenched as the answer came. He would tell Kushukh that Pitkhanas had said no one else could do the job as well. That should suffice.

And then, leading his own picked men, Tushratta would go to the palace and . . . He looked ahead again, to Pitkhanas's corpse being dragged away; to himself wearing the royal robes and enjoying the royal treasures; to lying with Azzias, surely the most magnificent creature the gods ever made. Standing outside himself for those images was easy. He had looked at them many, many times already.

After he had become king, Kushukh would prove no problem; locked in the old ways, he would hear and obey Tushratta just as he heard and obeyed the gods, just as he had heard and obeyed Pitkhanas. Tushratta was less certain of his own backers. He had not explained to them what a *bluff* was, as Kastiyo had for him. But he had repeatedly used the thing-that-seemed-this-but-was-that; he could not have risen half so quickly otherwise. They were quick lads. They might well see what it meant on their own.

If so—if he could never be sure that what one of them told him, what one of them did, was not a *bluff*—how was he to rule? They would not follow his orders merely because it was he who gave them. Must he live all his days in fear? That made him look ahead in a way he did not like, to see himself cowering on the throne he had won.

But why did he have to be the one cowering? If one of his backers tried to move against him and failed (and he would not be such easy meat as Pitkhanas, for he would always be watchful), why not treat that one so harshly that the rest were made afraid? No matter then whether or not they had his commands always ringing in their heads. They would obey anyhow, out of terror.

Would that be enough?

Tushratta could hardly wait to find out. ■

● *Conservative,* n. A statesman who is enamored of existing evils, as distinguished from the Liberal, who wishes to replace them with others.

● *Corporation,* n. An ingenious device for obtaining individual profit without individual responsibility.

Ambrose Bierce *(The Devil's Dictionary)*

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Jay Kay Klein's biolog

Practically the entire family of Eric G. Iverson has the unusual distinction of being native-born Californians including himself, his father, and his wife, and her parents. He attended two California universities; first, Caltech, where he decided the cold equations of a technical degree were not to his liking; then to UCLA, where he acquired a degree unusual even among the varied group of writers who appear in *Analog*: a Ph.D. in Byzantine history. He taught there, too, while studying under someone who had been a professor at the University of Athens.

Once vested with the mantle of one learned in the arcane subject of ancient Byzantium, Eric was brought short at graduation to discover there was not much of a market in Byzantine culture. Already having sold some writings professionally, he cashed this experience in by securing a job as technical writer for the Los Angeles County Schools Office, where he writes proposals, newsletters, and other material far distant in time, place, and spirit from the Golden Horn.

Fortunately, his background knowledge of fabled lands is of great use in writing fantasy and in dreaming up exotic backgrounds for science fiction stories. Under another name, he has also published a number of articles on the ancient world and a Byzantine chronicle translated from Greek. A 1979 two-volume sword-and-sorcery novel was the first piece of fiction he sold. Since then, Eric has appeared in *IAsfM* and other science fiction magazines. A fantasy tetrology is on the horizon now.

For would-be *Analog* authors, Eric cites Robert A. Heinlein's five rules for success in writing, which he has taken to heart. These appeared in Heinlein's guest editorial in the January 1974 issue:

You must write. You must finish what you write. You must refrain from rewriting except to editorial order. You must place it on the market. You must keep it on the market to sell.

In addition, Eric says he has also found George Orwell's six writing rules a helpful guide as they appeared in "Politics and the English Language."

Since photos of Eric are scarce and generally lack clarity, a verbal description is not out of place: middle 30's, six feet six inches, skinny, dark complexioned, balding, full beard, thick glasses becoming to an antiquities scholar. It might also be noted that his sharp mind does well in bridge and chess, but his not-so-keen eyes are a real handicap when playing first base in local sandlots. ■

Eric G. Iverson

Eric G. Iverson with newborn daughter, Ruth

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The Alternate View

THE DARK SIDE OF THE FORCE OF NATURE

John G. Cramer

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This column is devoted to a scientific mystery story. As we shall see, most of the mass of our universe seems to be in some mysterious and unknown form which we do not presently understand. This puzzle has gradually emerged from the work of physicists, cosmologists, and astronomers who are trying in various ways to determine and account for **all the mass in the universe**.

The mass-to-volume ratio of the universe is of **cosmic** importance. It determines whether the universe will expand (as it is presently doing) forever or whether it will eventually contract to a Big Gnab (the time-reverse of the Big Bang). The Big Bang is somewhat like a cannonball fired from a large Jules-Verne-style cannon on the surface of an airless planet. There is a "magic" cannonball speed called the **escape velocity** which measures whether its velocity "bank balance" exceeds the gravitational "debt" which must be paid to escape the planet's gravity well. If the cannonball leaves the cannon barrel with a speed greater than escape velocity it will escape the planet's pull; with less than escape velocity it will fall back; with **exactly** escape velocity it will move ever more slowly away from the planet, requiring an infinite time to escape completely.

The analog of this cannon is the Big Bang which three or so billion years ago sent all objects in the universe hurtling away from each other, as they continue to do today. There is, however, no "planet" from which these objects (gas molecules, stars, galaxies, clusters) may escape; rather, they seek to escape each other. There is a particular mass-to-volume ratio for the universe which is the analog of escape velocity. It is called the **critical density** and is about the density produced if six pounds of matter were smeared out inside a sphere that enclosed the orbit of the moon.

Cosmologists use the symbol Ω to represent the fraction of this critical density which is actually present in the universe. If Ω is greater than 1.0 the universe is overweight, and its expansion velocity is not enough to overcome the gravity pull of its mass; the universe is "closed" like a black hole and will ultimately collapse to the Big Gnab. If Ω is less than or equal to 1.0 the pull of gravity is too weak to cause collapse, and the universe is "open" and will continue to expand forever. The question of the ultimate fate of the universe reduces to a single issue: How big is Ω?

The simples way to get at Ω is to count stars per galaxy, galaxies per cluster, and galactic clusters in an average volume of space. With this information and the average mass of various types of stars Ω is calculated to be about .05% of critical density. But this mass-census

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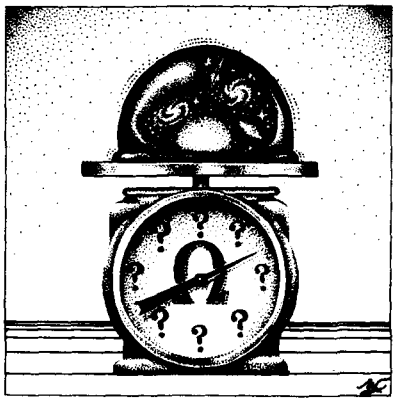
misses any "dark" matter, including interstellar gas and dust, nonluminous planet-size objects, dead stars, black holes, etc. This could represent a considerable fraction of the total mass of the universe, and is a serious error in the method.



Astronomers can measure the orbital velocities of bright stars at the extreme edges or "halos" of nearby galaxies, which gives the amount of galactic mass that lies within the orbit of the star. This method has led to a remarkable discovery: **there is about 300 times more mass in an average galaxy than can be accounted for by counting stars**. Only about 0.3% of a galaxy is in the form of visible stars, so the remaining 99.7% must be something else. This mysterious extra mass gives us an Ω which is about 15% of critical density.

This result is confirmed in another way. Shortly after the Big Bang the universe was a sort of nuclear pressure cooker, squashing together protons and neutrons to form most of the deuterium, helium, and lithium atoms we find around us today. The present fractions of these elements tell us a great deal about conditions inside the pressure cooker. To explain the nuclear isotope populations of today a value of Ω near 0.15 is required. Therefore, two independent methods, the orbits of stars in galactic halos and nuclear production in the early universe, indicate that the universe has about 15% of critical density. It must be so . . . or must it?

There is a compelling chain of logic indicating that Ω is *exactly* 1.0000 . . . and that the universe has *exactly* critical density. It appears very unlikely that today the universe could be within 15% of critical density by accident. Returning to the cannonball analogy, our "cannonball" (the universe itself) has been "rising" against the pull of gravity for about three billion years. In the process both the expansion velocity of the components and the strength with which they pull on each other have been reduced to tiny fractions of their original values. Two exceedingly large energy values (positive kinetic energy and negative gravitational energy) have almost canceled one another, and the very small remaining fractions of these energies are *still* within 15% of one another. To accomplish this the original energy values at one second after the Big Bang must have matched to one part in 10^{15}. At the time of "inflation" they must have matched to one part in 10^{49}. That two independent variables should match to such unimaginably high precision seems unlikely; there must be a mechanism. And although theologians tell is that God is good, could He be *that* good? Cosmologists prefer another mechanism to solve this "flatness" problem: according to the new inflationary scenario our

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universe has precipitated like a bubble from the energy-saturated H-space medium of the Big Bang. (See my September, 1984 Alternate View column.) The dynamics of the bubble itself produced both the expansion speed of the bubble walls and for the quantity of matter inside, "regulated" the value of Ω to precisely 1, both today and in the early universe.

And thus it emerges that we have **two** dark-matter problems: (a) "What is the dark matter (DM1) that makes up 99.7% of the mass of galaxies?" and (b) "What is the *other* dark matter (DM2) that raises Ω from 0.15 to 1.00?" DM1 must be clumped around the galaxies while DM2 must be uniformly distributed. Cosmologists distinguish between "hot" dark matter which arose from the extremely high temperatures present in the early universe, and "cold" dark matter which arose from tangles in the geometry of space itself in the early universe. Examples of "hot" dark matter would be any of several types of massive neutrinos possibly produced in the Big Bang. Examples of "cold" dark matter are such curiosities as "strings" and the "axions" discussed below.

The current opinion (8/84) among cosmologists is that DM1 of the galactic halos is of the "cold" variety, while the more generally distributed DM2 is of the "hot" type. This conclusion is supported by computer simulations that start from an early universe of smoothly distributed matter beginning to congeal from gravitational attraction and to follow the formation of galaxies and clusters, seeking to explain the galaxy-size clumpiness that we now observe. In these simulations different dark-matter prescriptions can be tried and the result observed. If dark matter is omitted there is not enough gravitational attraction to form galaxies. If "hot" dark matter is added there is too much attraction and the resulting universe looks nothing like ours. But when "cold" dark matter is added to the recipe, the familiar galactic lumpiness emerges in the universe contained in the computer cook-pot.

Is our universe really permeated with *two* distinctly different types of invisible stuff that accounts for most of its mass? That sounds very much like science fiction, doesn't it? OK, so maybe we should explore its science fiction implications. The leading candidate for the mysterious cold dark matter is a hypothetical particle called the **axion**. Axions have never been observed and (like magnetic monopoles) may be only a part of the mythology of particle physics. They are alleged to be tiny uncharged sloshings back and forth of space itself, sloshings which have both mass and energy but not much of either. It is estimated that the axion has a mass about 1/400,000,000 of an electron mass, and that there should be about half a trillion of them in each cubic centimeter of space in the vicinity of the earth, more per cc near the galactic center, but only 200,000 per cc in intergalactic space.

Axions have a geometrical resemblance to an electric and a magnetic field oriented parallel to each other. In theory, this property can be exploited to convert axions into photons (radio/light/gamma-rays) through the use of intense electric and/or magnetic fields. If cosmic axions were converted to photons, their estimated mass-energy would make electromagnetic microwaves like

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those used in home microwave ovens. It has been suggested that the axion-saturated space in our vicinity constitutes a "population inversion" of the sort exploited for lasers, and that under the proper circumstances it might be possible to make an axion-maser which converts this hidden energy embedded in space itself into a coherent beam of microwaves. Zap! However, before getting serious about building a pocket size axion-maser for barbecueing the opposition it should be realized that the available microwave power would at best be only about 3 milliwatts/cm^2 (about 2% of the energy content of sunshine on the equator at noon). This would make for a rather slow barbecue, but might be a useful energy source for other purposes.

However, the axion energy calculated depends on how rapidly axions enter the converion apparatus. I used a velocity of 0.1% c (light-speed), about the rate of motion of our solar system through the galaxy. If this speed goes up the available energy goes up accordingly. At near-light speeds the available axion-power would be about 3 watts/cm^2 times $\beta\gamma^2$, where $\beta = (v/c)$ is the velocity relative to light, and $\gamma^2 = 1/[1-\beta^2]$ is the square of the relativistic mass-increase factor. At a velocity of 99.9% **c** the available power from axions would be about 1500 watts/cm^2, enough power for a modest energy-efficient space drive. And the faster you go, the more such power becomes available.

The conversion of axions to photons has another interesting property: it makes momentum (or recoil thrust). Every axion that is converted to a photon with the same total energy and going in the same direction produces a momentum kick of $\Delta p = mc\gamma(1-\beta)$ where **m** is the axion rest mass. This would seem to make possible a fuelless "axion ramjet" which takes axions in the front and shoots photons out the back, pushing us through the universe in the process. However, there are several "engineering details" to be worked out. The solar system is not an ideal place to use such a drive because the local axion density is so small that a plausible engine would only have a thrust measured in micropounds. An axion drive would work best near the galactic center where the axion density should be high and worst in the voids between galaxies. We seem to need an "axion concentrator" to make the idea work (space-drive inventors please note). At high velocities one might think that the axion drive efficiency might be much better because the rate of axion intake is increased and because γ is larger. However, the push per axion goes down because the crucial momentum kick is obtained from speeding up the axion mass-energy packets to light speed, and as their incoming velocities begin to approaches **c** the kick gets smaller, reducing the effectiveness of the drive at high velocities.

So there you are, Dear Readers and Authors: the raw material for almost unlimited free energy, for energy beam weapons, and for fuelless (but flawed) space drives, all powered by the dark matter of the universe. Maybe Luke and Obi-wan shouldn't have been so down on the Dark Side of the Force. ■

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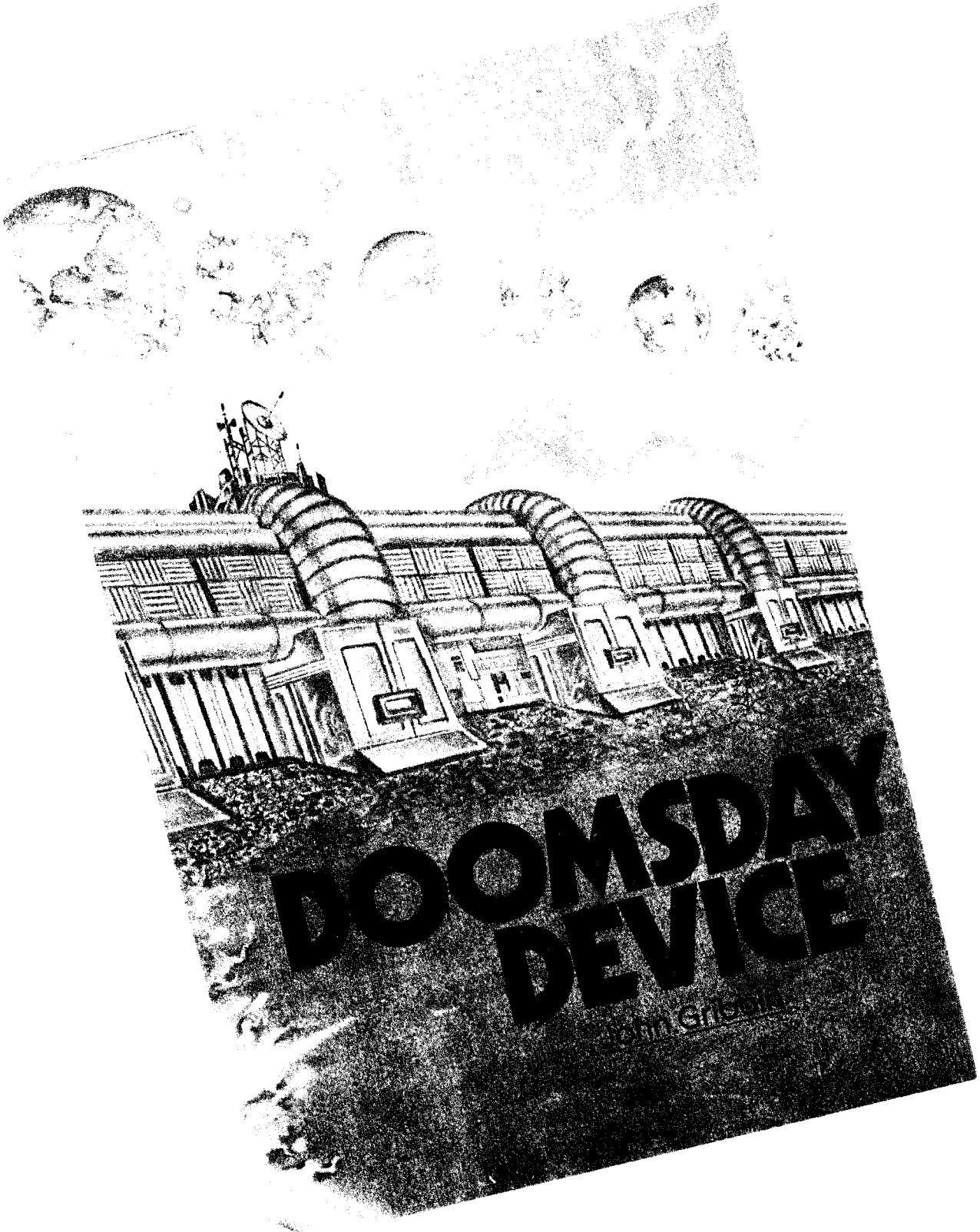

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"I know why the Desertron doesn't work." James Reed smiled and waited for the news to penetrate.

The gray head on the other side of the desk looked up from a pile of papers. Professor David Vernon, double Nobel Laureate and head of the giant accelerator project, paused with his pen raised, arrested in the act of signing yet another letter. "Don't keep it from me, Jim. If you're serious, for God's sake let me in on the news. The Congressional committee is coming next week, and if we don't have something to show them the whole shooting match is finished."

"OK. This is the biggest particle accelerator in creation, right? The next best thing to the Big Bang itself. We smash the beams together out there," waving vaguely at the desert view outside the windows, "and use the energy to make particles that haven't existed since the moment of creation. Only it doesn't work. Up to ten or a hundred trillion GeV, everything is hunky dory. But when we push the energy above a trillion GeV, nothing. There's no reason why it shouldn't work at higher energies, and the low energy runs check out everything in the theory. So I reckon the answer's simple. It *is* working, but we can't see it."

"I don't have time to play guessing games, Jim." Vernon sighed and signed a couple of letters. "I'm sure you've got something up your sleeve, so get on with it. Put up, or shut up and let me face the music."

The smile left Reed's face. Things really were getting out of hand, if Dave Vernon couldn't take a joke and wouldn't try to guess what he was driving at. That was the trouble with administration—it killed scientific curiosity. To Jim, it was still a game. The machine didn't work as planned. Never mind. If it *had* worked as planned, that would only tell them that their ideas about the Universe were more or less right. It was when things went wrong that one got a chance to find out new things. If the old ideas were wrong, that meant there was something new out there to be discovered. That, after all, was what science was all about. But try telling that to an administrator, or a Congressional Committee.

"You're too bogged down in details, Dave. Not just all this administrative stuff. The scientific nit-picking as well. I'm not talking about a mistake in the *n*th integral of one of the collision tensors. Its much simpler than that, and more profound.

"Look at what actually happens. We test all the components separately, and they check out 100 per cent. We stick it all together, press the button, and nothing happens. So we take it all to bits, and find some trivial fault. Not once; not twice. *Every time* we try to make the Beast perform as specified."

"You aren't going to tell me it's sabotage. Security really is tight."

"No. I told you, its nothing on that detailed a level. Step back from the problem and think about the fundamentals.

"Where and when was the last time anything that energetic was running? In the first split-second after the Big Bang. That's why we built the thing—to test particle creation ideas and the unified field theories that tie in with cosmology. So I asked myself, what *laws of physics,*

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not human errors, might prevent such energetic events happening today, now the Universe has been cooling down for fifteen billion years."

Vernon put down the pen. He knew that light in Reed's eye. After all, Jim was the spiritual heir of Stephen Hawking, the man whose work on supergravity was the foundation of the physics the Beast was supposed to test.

"You're talking about the cooling of the vacuum. Are you telling me that superenergetic events can't happen in a cold universe?"

"Not quite. The vacuum isn't empty space, of course, its a continuum filled with energy and fields. But it is the state of minimum energy that the Universe cooled into after the Big Bang. You know the old analogy, its like a ball rolling down a "U" shaped valley and settling at the bottom. What I'm suggesting is, the low energy state our vacuum is in isn't the only state."

Reed stood up and turned to the board opposite the Director's desk. Pulling a red marker pen from his pocket, he drew a couple of wavy lines on the white surface.

"There could be lots of minima, but let's just consider two. It isn't like a U shaped valley, but an uneven W, with one side dipping much lower than the other. What I'm suggesting is that when the Universe cooled after the Big Bang, the vacuum settled down into the state corresponding to the higher valley—the higher local minimum. There *is* at least one even lower energy state, but we are separated from it by a little energy hill. It's in the valley next door."

He turned back to his seat, put the pen away and sat down. "When we put enough energy into our Beast in the Desert, we are pushing the particles we make up over that hill and down into the next valley. In fact, they tunnel through before they get to the top, because of quantum uncertainty. But it comes to the same thing."

"You mean, we *are* making ultra high energy particles, but they are escaping from our Universe?"

"Come on, Dave, you know better than that. Once you have a channel through from the higher energy state to the true vacuum, *everything* would go through. The whole Universe would switch over to the true vacuum state, releasing an enormous blast of energy and creating an expanding bubble of true vacuum growing at the speed of light. Its just like the energy release that caused the Big Bang—the inflationary model that Guth thought up in the '80s."

"But it doesn't. *Nothing* happens when we try to run the machine. It doesn't work at all, and it certainly doesn't destroy the Universe as we know it!"

"No. But it *would*, if it did work. Can't you see it yet? *If* the machine works, the Universe is destroyed. We are only here to puzzle about why the machine fails *because* the machine fails. There's only one way to explain that in terms of fundamental physics. It has to mean that Everett's idea of multiple realities is right.

"You know the thing I mean. Every time the Universe is faced with a choice of alternatives, at the quantum level, it actually 'chooses' all possibilities, splits into two or more independent universes that then go there own separate ways.

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Like the idea of 'parallel' realities in science fiction, only really the alternative worlds are all perpendicular to one another.

"What I believe is, every time we run that machine it does destroy the Universe. It destroys a whole slew of universes. The only universes that continue to exist afterwards are the ones in which, for some reason, the machine didn't work. So we perceive a plague of little faults that stop the machine working as planned."

"It's crazy." Vernon sat back in his chair and looked Reed in the eye. "You know that story about Niels Bohr, when someone came up with a new idea about quantum theory in the 1920's. He said it was crazy, but not crazy enough to be true. I wonder if this idea *is* crazy enough to be true."

"Why not? Look how beautiful and simple it is. It confirms the unified theory is right, because the machine works. It confirms the Everett many worlds theory is right, or we wouldn't still be here to talk about it. That doesn't leave many questions to answer. Why, it really means the end of theoretical physics. The ultimate answer. I ought to get another Nobel Prize for this, and then they can scrap the physics prize altogether. And maybe I'll get the Peace prize too." Reed grinned. "Then I'll have one more than you."

This was more like it. Dave no longer looked like a tired clerk, but more like the eager scientist Jim had crossed swords with in the past.

"*Peace* prize, Jim? How come?"

"Like this. Now we know what we are doing, we can redesign the Beast so that there are no moving parts to go wrong—everything working at the quantum level. Then, if anyone presses the button it really will be the end of the Universe. I bet you can see what will happen. Anyone who tries to do the job will have a silly accident, or just change his mind. Nobody will ever bring himself to try it, in our Universe, because in all the universes where it is tried, we won't be around any more to notice. The Universe in which we are around to see what is going on just has to be one of the universes in which nothing happens. So you have to automate the Beast fully, seal it up and leave it set to trigger under one condition, and one only—if it detects an upsurge in radiation consistent with the start of a nuclear war."

"Do you think that would bring peace? If everyone knew that war would cause the destruction of the Universe?"

"Not at all. We don't even have to tell anyone what we've done. All I'm doing is selecting out *all* the universes in which there *is* a holocaust and destroying them, painlessly. The only worlds in which consciousness survives will be the ones in which there are no nuclear explosions. As far as our awareness is concerned, the world will stagger from crisis to crisis, like before, but for whatever bizarre and unlikely reasons nobody will ever press the button to start the holocaust.

"What do you think the Congressmen will make of that?" Reed sat back with the smug expression of a man who knew he had done well.

Vernon looked thoughtful. "You know, Jim, you could even be right. But you've still got the same sloppy habits—never think things through to the

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end. You said things would continue as before, staggering from one crisis to the next but stopping just short of all out nuclear war. Didn't you stop to wonder why we have avoided the holocaust so far?

"Afghanistan, Lebanon, Central America, the Alaskan crisis of '93, this trouble last year in Mongolia. We've been on the edge of nuclear war for the past thirty years, but every time peace has been maintained by a series of bizarre accidents. As bizarre as the accidents we've been having every time we try to run the Beast.

"I can even put the finger on when it all started, when detente cooled off and the second Cold War began, in the late 1970's. Remember all the fuss in those years about the mythical 'beam weapons' the Soviets were supposed to be building, to shoot down our satellites? They were certainly building something, but nobody ever found out what and no satellites were ever knocked down by it.

"Your anti-Doomsday Device is a great idea. But I don't think it will ever win you a Nobel Prize. You have to be original to earn that. And would you take a bet that someone hasn't beaten you to it?" ■

● Our March issue starts a big new serial by Charles Sheffield—big not only in terms of four instalments, but in sheer scope of the story itself. Those who bemoan a lack of "sense of wonder" in recent science fiction should find a lot to keep them happy in *Between the Strokes of Night*. It starts modestly enough, in a research lab seeking nothing more than to do away with one of the most fundamental human limitations, and builds outward to—well, I won't tell you where it eventually winds up. I'll just say that the world as we know it is a thing of the past not far into the story, and just when you think there can't possibly be anything more to tell, the story *really* takes off and its scope keeps expanding all the way to the end. All along the way you'll find a steady stream of the mind-stretching ideas Sheffield is noted for, and you'll spend a good part of the journey in a world that's wildly different from any reality you've known—or is it?

The fact article, "Hot Rocks and Water" by Richard Patrik Terra, also starts close to home and then moves out, but it's about alien environments and lifeforms throughout. It seems there's a whole new kind of ecology right here on Earth, its existence unsuspected until just a few years ago, intriguing in its own right and suggesting even more intriguing possibilities for other places. **IN TIMES TO COME**

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YOUR NAME IS BILL JOHNSON. YOU HAVE STOPPED A MAN
FROM BECOMING A DICTATOR AND ENDING A GREAT EXP
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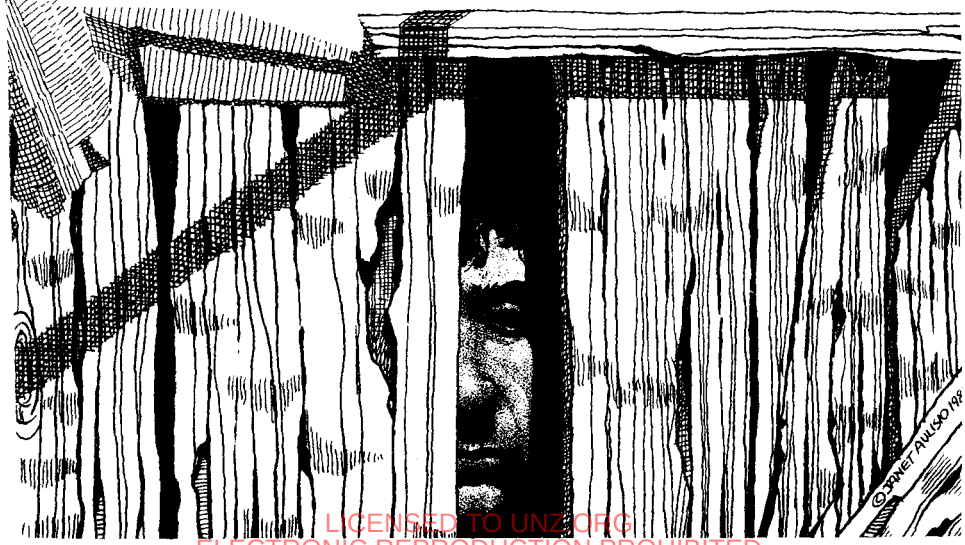
TOUCH OF THE MATCH

James Gunn

The first colonists on a new frontier may not be the "obvious" candidates.

The room was illuminated only by the feeble glow of a night light through the open door of a white-tiled bathroom. The man lying quietly on his back, his arms extended beside his body outside the covers, opened his eyes and stared blankly at the ceiling. His eyes blinked once and then twice quickly and then he threw back the covers and sat up, swinging his legs over the side of the narrow bed, and put his face into his upturned palms.

It was a good face, brown and well formed, but now it was blank as if all the character shaped by a lifetime of crises and decisions had been erased from it. The man lowered his hands and stood up carefully. He walked to the glow of the bathroom and turned on the light. He tried to look at his face in the mirror over the lavatory, like a man trying to verify his identity after a bad night, but the mirror was covered with small, precise red letters. The man re-



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focused his eyes on them.

"Your name is Bill Johnson," the letters said. "You have stopped a man from becoming a dictator and ending a great experiment in democracy, and you don't remember. You may find the newspapers filled with reports of what happened, but you will find no mention of the part you played.

"For this there are several possible explanations, including the likelihood that I may be lying or deceived or insane. But the explanation on which you must act is that I have told you the truth; you are a man who was born in a future which has almost used up all hope; you were sent to this time and place to alter the events that created that future.

"Am I telling the truth? The only evidence you have is your apparently unique ability to foresee consequences —it comes like a vision, not of the future because the future can be changed, but of what will happen if events take their natural course, if someone does not act, if you not intervene.

"But each time you intervene, no matter how subtly, you change the future from which you came. You exist in this time and outside of time and in the future, and so each change makes you forget.

"I wrote this message last night to tell you what I know, just as I learned about myself a few days ago by listening to a recording in a used-record shop, for I am you and we are one, and we have done this many times before."

The man stared at the message for several minutes, his face slowly changing from comprehension to understanding to acceptance, and then he took a washcloth from a rack beside the lavatory, moistened it from the hot water tap, and wiped the mirror clean. He stared down at the red smears on the cloth for a moment as if wishing that he could wipe other things away as easily and then tossed it into the clothes hamper in the corner.

After he had showered and dressed in the oldest clothing he found in the closet of the windowless room, he put into his pockets a small heap of belongings from the top of the small dresser. They included a few coins, a black pocket comb, and a billfold. In the billfold were a Visa credit card, a five and three one dollar bills in U.S. currency and one hundred seventy-five dollars in twenty-five dollar bills printed in black, yellow, and red and labeled "King International Scrip." In the center of the bills was a full-color picture of a man with white hair but a strong, tanned, and youthful face. Underneath the picture a legend said, "Arthur King."

The man put his few belongings into an old suitcase he found in the closet. He left hanging in the closet a navy blazer and a pair of gray slacks that seemed to go with them, and made his way down a gray concrete corridor lined with closed doors on one side and a solid wall on the other, past a busy dining room and kitchen that seemed to have been carved out of rock, and up a flight of stairs to a well lighted living area. In front of him was a glass-walled atrium. On either side of the atrium was a wide hallway. Doors opened off the hallway on either side. The atrium was bright with morning sun and filled with sand and cactus, snakes, lizards, and birds, and other desert creatures.

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The man paused as if he would have liked to have stopped and watched the atrium scene, but at the far end of the hall—where one might expect to find a front door—men were busy with some kind of construction work, and he went toward them. As he passed the open doorway of a room filled with books, a woman with a face like an arrangement of chisels and anvils looked up from the enormous desk she sat behind. "Johnson?" she said. "Where do you think you're sneaking off to?"

Johnson put his suitcase down beside the door and stepped into the room. "Whatever I've been doing here," he said in a gentle, well modulated voice, "has come to an end. I belong somewhere else."

"You'll go when we tell you it's time to go—" she began, and was interrupted by the opening of the door to her left.

A tall, white-haired man stood in the doorway. He wore a blue robe that looked as if it had cost as much as some men's suits. His face was the one pictured on the King International scrip, but it was softer in real life, less touched by destiny, more reconciled with life as it is. He evaluated the scene at a glance. "Johnson?" he said. "You're leaving us?"

"He thinks he's leaving," the woman said.

"If Bill wants to leave, that's his right," the white-haired man said, "but I hope he won't." The woman looked scornful. "Oh, I know, Jessica, you still hold Bill responsible for the collapse of our presidential hopes, but that's folly. He was nowhere near any of the equipment. No, it was my own stupidity. I cut my own throat. I'm just sorry I cut yours in the process. It's too bad. We would have made a good president, you and I."

The brief expression of wistfulness passed from his face, and he turned to Johnson. "It's happened again?"

"Yes, Mr. King."

"But you know my name."

"It was on the scrip."

"Of course," King said. "You know you're welcome to stay, to pick up what you've forgotten."

"That wouldn't be fair to those who have memories of relationships or to those who would have to instruct me again in everything I was supposed to have learned. It's better for me to be among strangers."

"It's a hard world out there," King said. "A man needs friends and walls to protect him. There's a lot of passion in the world, a lot of hatred, a lot of angry people with bombs and weapons in their hands. I thought maybe I could do something about it, but it wasn't to be."

" 'The best lack all conviction,' " Johnson quoted, " 'while the worst are full of passionate intensity.' "

"You remember Yeats?" King said.

"It's just Johnson I forget."

"I can see there isn't any stopping you."

"There's always a way," Jessica said.

"I used to think that," King said. "Now I'm not so sure. I think there are some things we must accept the way they are. And maybe that's best. We can relax, enjoy life, people. Angel and Evangeline will miss you. I know you don't remember them, but Evangeline is my wife and Angel is my daughter,

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and they are very fond of you."

"Tell them goodbye for me," Johnson said. And he turned to the door and picked up his battered suitcase and walked down the corridor and out the front door past the workmen who were putting armorplate coated with imitation wood on the outer door. Beyond, other men were building a heavy metal entranceway.

"What's that?" Johnson asked.

King answered from the doorway behind him. "That's one of those new anti-bomb devices. Radio waves detonate any kind of chemical explosive. When these get installed all over the world, it will take care of the terrorists for sure."

Johnson looked through the tunnel formed by the device as if he could see far down it to a vision at the end of the world. "I hope so," he said. "Civilization depends on trust. Without trust there may be no future."

King looked at the construction and smiled. "Not as long as people are strong."

"Or sensible," Johnson said. "May the future be kind."

The Los Angeles airport had been fortified. Barbed wire encircled the entire perimeter, and tank traps had been placed wherever it was possible for an automobile or a truck to approach a runway or a building. All incoming vehicles had to park far from the terminal, and the passengers were transported to their airlines in electric buses that passed through metal tunnels—larger versions of the entranceway Johnson had seen being built to King's residence. Even the electric carts and trucks that dashed around the airport itself were funneled through similar devices on the field.

Johnson studied it all as he made his way by bus and foot to the counter where he bought his ticket. He had to sign a form swearing that he had read the list of materials that would explode and that he had none of them on his person or in his luggage, and a waiver of responsibility for damage to body or property that might be caused by such explosions. He also had an opportunity to purchase temporary insurance against any of these contingencies. That application he threw away.

He and his bag passed through a series of devices without incident, and he found himself on an airplane sitting in the middle seat of three on the right of

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the aisle. On his right was a pretty, dark-haired young woman who seemed to be frightened at the prospect of taking off. On his left was a dark-haired, brown-faced young man who seemed nervous for some other reason.

Johnson turned to the woman on his right as the plane engines began to roar and the plane picked up speed slowly for its takeoff. "First time?" he asked. She nodded, apparently unwilling or unable to speak. "Don't worry," he said. "Everything will be all right."

"It's not the airplane I'm afraid of," she said breathlessly. "It's the people on it."

"They've all been checked," he said. "There's nothing to worry about."

"There always are things to worry about these days," she said. "Every time you leave the house you worry whether some crazy fanatic will blow you up before you return. Not because he hates you. Just because you're there. And if you don't leave home you still worry. Lying in bed at night. Maybe the car engine you hear at night that stops near your house is a bomb waiting to go off."

"Then you can feel safer here," Johnson said.

"They're clever," she said. "They always seem to find a way of getting around everything."

As if that were a signal—though it was more likely the fact that the plane was committed to flight—the brown-faced man beside Johnson sprang to his feet and held his right hand threateningly in the air. "Nobody move!" he said with a Middle Eastern accent. "I have bomb. It go off if this plane no go to Teheran!" The last word he said so well that it was almost incomprehensible.

One of the flight attendants approached the man from the front of the cabin. "Now," she said soothingly, "you know you don't have a bomb. Just sit down, and we will be in Washington before you know it. You can get a flight there to Teheran."

"I have gun," the dark-complexioned man said.

"Now you know you don't have a gun," the attendant said with professional calm. "You can't get a gun through the detectors."

A male flight attendant moved up behind the hijacker but made no attempt to seize him.

"I have new bomb!" the hijacker said desperately. "No set off."

"You know that's not true," the attendant in front said. She reached out a hand to turn him back toward his seat. Defeated, the would-be hijacker turned and allowed the attendant behind him to help him into his seat beside Johnson.

"I fail," the dark-complexioned man said disconsolately and then spoke a few rapid words in a foreign language. He stared down at his hands clasped helplessly in his lap.

"What kind of person would try something like that anyway?" the girl by the window demanded, her voice breaking from tension.

"He must be a person under a great deal of stress," Johnson said.

"That's no excuse!" the girl said angrily.

"I fail," the man said again. "I die."

Johnson spoke to him quietly, to the indignation of the girl by the window and perhaps, by the shufflings around

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him, to the indignation of everyone within earshot. For a long time, while the airplane rose above the mountains and soared above the desert, the man didn't respond. Then, finally, he began to talk to Johnson in his broken English, and the tragic story of his life emerged.

Born a displaced Palestinian, he had grown up in the squalor of Lebanese camps. His mother had been killed by Israeli bombs, and his father and brothers had given their lives in terrorist activities when he was twelve, leaving only him and his sister. He had joined a fundamentalist Iranian group pledged to martyrdom, but he had been weak. He had been concerned about his sister's welfare. With the help of the organization, he had been slipped into this country with forged papers in order to blow up important installations or government buildings when he was given instructions, but really he had tried to get a job so that he could send money to his sister in Lebanon.

But there were no good jobs and little money, and when the instructions came he was afraid—not so much for himself, he wanted Johnson to understand, but what would his sister do if there were no money at all?

Finally, there was nothing to do but to try to return. He had no money for airfare, and his terrorist comrades would not welcome him back with his assignment unfulfilled, but perhaps if he returned with an airplane of the Great Satan it would be considered an honorable act, and if he died in the attempt perhaps the group would care for his sister.

"Can there be no end to the killing?" Johnson asked.

"Not till there be justice."

"What kind of justice?"

"We get back our land."

"What is justice to one may be injustice to another."

"Let others suffer."

"Their suffering would lead only to acts of desperation such as yours. More violence. More terrorism, this time against you rather than yours against them."

"Then there be no end, even with justice." The Palestinian accepted that outcome fatalistically as if everything could end in blood and destruction and he would not complain.

"What if the Palestinians were given other land?"

"Where is land to give away? No matter. It not be Palestine."

"What if it were better? What if Palestinians could come to this country like the Vietnamese, could have jobs, could make new lives for themselves."

"It not be Palestine. For me, maybe good. For my sister, yes. For others there still be hatred. Those would not come; their anger be watered, or they be dirtied by the Great Satan, or if they come it only be to destroy."

Johnson looked toward the window on his right. It had been a long conversation that had lasted through lunch, and the airplane was descending into Dulles airport. Green hills were visible, and dark clouds could be seen mounting into thunderheads far to the south.

When Johnson raised his eyes, the girl in the window seat was looking at him. She was frowning. "You see?" she said. "There's no use talking to them."

Before Johnson could reply, the plane

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leveled off and made a right turn. The speakers above their heads offered the peculiar hush that always preceded an announcement, and then an authoritative voice said, "This is Captain Bradley, folks. We're going to have to delay our descent into Dulles airport for a few minutes, and we'll be circling in a holding pattern along with all the other planes about to land. This has been an eventful flight, but there's nothing to be alarmed about. It seems that the space shuttle was committed to a landing at Cape Canaveral when an unexpected thunderstorm sprang up along the Florida coast. Those passengers on the left side of the plane can see it if they look far to the south. The shuttle has been diverted to Dulles, and all traffic has been delayed until it lands. It should be an occasion. Maybe we'll get a glimpse of it as it comes. . . . There it is!" The captain's voice was suddenly excited, before it descended again to its customary calm. "Those passengers on the right can see it—a speck of white at two o'clock. Passengers on the left may be able to pick it up soon. . . ."

And so it was that they were allowed to land shortly after the incredible white delta-shaped machine had preceded them by a few minutes into the airport. The passengers cheered and clapped, as if they had forgotten for a wonderful moment the terror in which they lived. Even the Palestinian beside Johnson had craned his neck for a look at the shuttle.

The terror began again after they had been herded into several of the tall vehicles that were intended to ferry them between plane and terminal. Midway, the vehicle that was carrying Johnson and his seatmates and some fifty other passengers made a gentle arc whose purpose was not perceived until one of the passengers saw the terminal out of the right-hand windows and said, "We're heading the wrong way."

A babble of voices, rising in volume and querulousness, began shouting questions. People turned in their seats to look out the windows and some of them got up and looked toward the front where two uniformed figures were half hidden in the control cubicle in the front.

As the noise level increased, one of them turned, opened the glass door, and stepped into the passenger area. "All be silent!" the person shouted. It seemed like a woman's voice, though it was hard to tell, because it was husky and the accent was foreign. The figure fumbled at its belt and then pulled free a black knifelike object. The figure held it up threateningly. "Silence!" it said again.

One of the flight attendants stepped forward. It was the same one who had dealt with the Palestinian on the plane. "There's no use threatening us with that. You can't hold off all of us." The noise level had dropped so that the attendant's words were heard by everyone.

"I kill many," the terrorist said quietly, and the words were more frightening for their lack of intensity. Clearly it was a woman's voice, and that was more frightening yet. The flight attendant took a step closer and a few of the bolder passengers behind surged forward. "You I kill first," the terrorist said to the flight attendant. The flight attendant tried to shrink back but was

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unable to retreat more than a step because of the bodies behind her.

The terrorist waved her dagger at the mass of them. "If you attack and not die, my comrade crash bus. This bus not go fast but fast enough, and if raised crash do injury to many." As if in response to her words, the body of the vehicle began to elevate itself from the ground. The balance seemed to shift from side to side as if it were about to overturn, and people shrank back into their seats to keep it stable. The flight attendant retreated to a seat at the far end and seemed willing to have someone else assume responsibility.

Johnson stepped forward. "No one is going to do anything rash—"

"Appeaser!" said the woman who had been seated beside hime in the airplane. "Terrorist-lover!"

The terrorist waved her knife at the woman. "You! Come!" She motioned the woman forward.

"No," the young woman said faintly, trying to fade into her seat.

"You!" The terrorist rapped once on the glass door behind her. The vehicle turned and leaned, turned back and leaned the other direction. The passengers tensed and tried to keep the mobile lounge from tipping over by shifting their weight in the other direction. "You!" the terrorist repeated. "Come!"

The young woman shrank back, but the passengers around her pushed her forward until she stood, trying to retreat, beside Johnson. "Don't be afraid," Johnson said, taking her arm reassuringly. "You won't be hurt."

"You not be hurt," the terrorist said in her husky voice, "if you do as told—if all do as told. You—hostage. You and you," she said, indicating Johnson and the young woman. "If any move wrong, these die first." She reached up with her left hand and removed her uniform cap. Black hair fell around her shoulders. Now there was no mistaking her sex. She was a beautiful woman, even though her face now was set in an expression of savage determination.

"Fatima!" a foreign voice said from among the passengers. The Palestinian who had talked so long to Johnson stood up and started forward, hands half raised as if beholding an apparition.

"Fatima?" the Palestinian said again.

The woman had raised her dagger in quick alarm. "You know my name? How—?" And then, "Mohammed? It be you?"

They both spoke rapidly in a foreign language as they approached. A sequence of emotions crossed their faces. The Palestinian called Mohammed was about to embrace the woman he had called Fatima when she stepped back and motioned with her dagger at the passengers. "I always ready," she said. "Not do anything." She stepped forward and put her arms around Mohammed.

"That man is under arrest," the flight attendant said. "He tried to hijack the plane to Teheran."

Fatima's face brightened. "Ah, Mohammed! You try!"

Mohammed looked despondent. "I fail."

"He's still under arrest," the flight attendant said.

"No more," Fatima said proudly. "My brother go with me. He freedom fighter like me."

The mobile lounge slowed, and she

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stepped back from her brother. The compartment lurched as the lounge turned. Through the forward windows Johnson could see the white bulk of the space shuttle. When it came into the view of the seated passengers on the right as it passed the shuttle's tail, some of them gasped and others began to talk excitedly.

"You and you!" Fatima said to Johnson and the young woman. "Out!" She motioned toward the front of the vehicle. After they had passed, she reached down and took another plastic dagger from her boot. She handed it to Mohammed. "You follow! Guard!" She turned to the other passengers. "Far to ground. Anybody move, these die. You be killer." The lounge had stopped with its front pressed to the left side of the shuttle.

The shuttle, still warm from its passage through the resisting air, stood at the end of a white runway marked by the black skid marks of innumerable airplane wheels that had touched down there in the years since the airport had been in use. The four of them stood with their faces close to the radiating white tiles. The shuttle looked much bigger than it had looked from the air.

A dark-faced young man in uniform emerged from the control booth beside them and knocked sharply on the shuttle's side. A crack appeared in the tile and widened into a square oval of darkness. A middle-aged man in astronaut's uniform appeared in the entranceway, blinking in the sunlight. As he moved onto the lounge's platform, the young man who had knocked moved back into the control booth and pushed something. The lounge began lowering.

"What's happening?" the astronaut asked.

"But that's Henry Chrisman," the young woman beside Johnson said almost simultaneously.

As both sets of words still seemed to hang in the air the woman called Fatima had moved beside the astronaut and placed the tip of her dagger under his chin and her left hand on the man's shoulder so that he could not draw back. "Not resist! No move quick. No one get hurt."

The lounge had reached the ground. "Come!" Fatima commanded, leading Chrisman forward. Johnson and the others followed as Fatima motioned to Mohammed to bring them off the lounge. The lounge retreated from the shuttle's side about ten feet and then began to raise itself once more into the air. The dark-faced young man in uniform slipped from the booth and dropped to the ground.

Fatima led them around the nose of the shuttle as voices came from the shuttle's hatchway above, calling to Chrisman and demanding to know what had happened. On the other side of the shuttle a tow truck was pulling to a stop and an electric car was approaching.

Mohammed spoke rapidly to Fatima in the foreign language they shared, and she responded curtly. A man in coveralls got out of the passenger side of the tow truck. "What's that lounge doing here? Has it got people in—?" The man saw Chrisman and stopped.

At the same time the electric car came to a stop behind the truck and the driver got out. "What's going on—?" He stopped.

"All you—truck driver, too," Fa-

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tima said, pressing her dagger into the soft flesh under Chrisman's chin as if to emphasize her command of the situation. "Go other side of shuttle. Stay! Do right, Chrisman not be hurt. Hostages not be hurt. Do not—be much bloodshed."

The driver of the truck got out of the far side. Chrisman said, "Do as they say. Let's get as many people out of this as we can."

Slowly the three men strung themselves out and rounded the nose of the shuttle.

"Get into car—back seat." Fatima told Johnson and the young woman. "Get in also," she told Mohammed. "Keep knife ready. Kill if move." Mohammed swallowed hard and followed them.

The young man in uniform led Chrisman to the automobile and pushed him into the passenger side of the front seat while Fatima was getting into the driver's side. "This electric car," she said. "Only steer and push to go. Right hand for knife. Mohammed has knife. You move; you die."

"Don't worry," Chrisman said calmly. "I'm not going to do anything rash, and I'm sure these others are not going to do anything either."

The young woman murmured something weakly that sounded like assent, and Johnson said, "We'll all be sensible."

Ahead of them the tow truck began to move, and the car in which the rest were riding followed as it left the runway and, picking up speed, headed toward a section of fence around the perimeter of the airport. A moment later it plunged through the fence and the car followed through the gap, crossing the flattened chain links. In a few moments, rolling across grass, the truck with the car behind it had reached the highway. The truck stopped. The driver got out and opened the car door beside Chrisman, motioned him to move over, and got in beside him, his knife in his hand. The car rolled onto the highway, got off at the first exit, and pulled up behind a traditional automobile parked along a side street. They got into the other car and it sped off into the hills of Virginia.

The building was an old farmhouse. They reached it by a dirt road after they had been traveling in hills for a half-hour. It was isolated: they had not seen another dwelling for at least fifteen minutes. The house was set in a valley and was surrounded by large trees. It would have been a pleasant place under other circumstances. The hostages did not see the inside of the house, but it looked as if it had not been occupied regularly for some time. The roof was mossy and places on it seemed damp or discolored, and the wood siding had not been painted for many years.

The hostages were led to a barn that seemed even older and in poorer repair than the house. It had been converted into a prison by nailing shut all the doors except a small one set into the main barn door, and then new planks, startling in their contrast to the weathered wood they covered, had been nailed across all the openings, including the hayloft door. The hostages were led and pushed from the car to the barn and through the small door. When they were close, they could see that it had been equipped with a large new bolt.

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The young woman was tense and seemed close to hysteria. Chrisman was calm and thoughtful. Johnson was quiet, as if he knew something that the others did not. Mohammed was nervous, particularly when his sister told him that he would stay with the hostages inside the makeshift prison.

"Let's talk this over," Chrisman said, turning just inside the barn, looking out through the still open doorway at his captors. "Surely we—"

"No talk," Fatima said. "Talk for leaders. They do what we ask, you go free."

"But what do you want?"

"No talk!" she repeated fiercely.

At her tone, her uniformed companion lifted the revolver he had retrieved from the glove compartment of the car and waved it threateningly. Chrisman opened his mouth again and Johnson touched his arm cautioningly.

Fatima took the plastic knife from Mohammed's shaky hand. She said something in their foreign language. Mohammed protested, and then she spoke in English. "You no need. Guard outside. They attack, you yell. You listen! They plan something, they whisper so you not hear, you tell. We bring food soon." She pushed him gently inside and closed the door behind him.

They stood in the semi-darkness of the barn's interior. The night was not yet upon them, but here in the valley only a few beams of sunshine penetrated, and only a few of those got through chinks in the barn's siding; still it was enough to reveal them to each other and the interior of the barn. On the dirt floor a few worn blankets had been tossed on mounds of old hay. The place smelled of dirt and mold and decaying vegetation. On the left a ladder led to the hayloft. Chrisman climbed it with catlike grace, moved around in the loft, and then quietly came back down.

"Well," the young woman said, her voice close to breaking. "Is there a way out?"

Chrisman looked at Mohammed.

"You're the great scientist!" the girl said. "Surely you can find a way out for us?"

"There's a solution to every problem," Chrisman said evenly. "But we don't want to discuss it in front of our guard here."

"He won't do anything," the girl said scornfully. "He couldn't even hijack an airplane."

"I try," Mohammed said. "But if you talk I must tell. If you go apart to talk, I must tell that, too. I not want to see harm come to you. I not want to see bad things happen. But I must do these things that I am told."

"Any solution ought to involve Mohammed," Johnson said reasonably. "It ought to be good for him, too."

"Sometimes it's impossible for everybody to win," Chrisman said.

"And sometimes if everybody doesn't win, nobody wins," Johnson said. "We've all had experience with that lately. But first maybe we should introduce ourselves. I'm Bill Johnson, and this is Mohammed."

"I gather some of you already know me," Chrisman said. "I'm Henry Chrisman."

"And you invented the bomb neutralizer among other things," the young woman said. "That almost solved the terrorist problem."

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Mohammed's face brightened with understanding. "Ah, yes—!"

"But not quite," Chrisman said ruefully. "And you are—?"

"Jan Delaney," she said. "I'm nobody. I was going to visit my sister in Washington when all this happened. My first trip to Washington. My first trip anywhere on an airplane. And all this had to happen—! I'm a computer programmer in Los Angeles, and I should be used to machines, but I'm not—"

"I'm just a nobody, too," Johnson said. "But maybe if we try very hard, we can come up with an answer to this problem."

"It must have been just a great stroke of luck, picking me off like that," Chrisman mused. "They must have had their people planted at Dulles waiting for a target of opportunity, and I fell into their hands. They might have had to wait for years." His voice changed. "My wife will be worried."

"My people learn patience," Mohammed said proudly.

"I hope they are able to learn something else," Johnson said.

"We can always kick our way out of here," Chrisman said, looking at Mohammed. "This old barn is ready to fall apart if you lean against it. But it will make noise. The question is: who will get hurt?"

"We don't want anyone to get hurt," Johnson said.

"Mr. Johnson here is not only a lover of terrorists," Delaney said scornfully, "but a coward as well."

"If anyone gets hurt," Johnson said, "it not only will be a personal tragedy, it will make the situation worse for everybody."

"The question is: what are their demands?" Chrisman said, leaning back against a pillar. The pillar creaked, and Chrisman straightened up.

"No matter what their demands are, we can't do anything about them," Johnson said. "And no matter what the official response is, it can't make anything better."

"How's that?" Chrisman asked. He spread a couple of blankets on the hay and sat down on one of them. "Sorry," he said to Delaney. "I've had a hard day."

"So have I," she said, and sat down on the other blanket, not far from him, as if casting her lot with the famous scientist. If it came to a vote, it was clear, it would be two of them against one of Johnson.

"All they can ask for is something that will improve their ability to terrorize: jailed terrorists, a dismantling of security measures, money, weapons, airplanes," Johnson said evenly. "They know they can't get Palestine back for us." He looked at Chrisman and smiled. "For you. We don't count."

"In this kind of thing," Chrisman said, "nobody counts. We're all pretty small in comparison to the size of the problem."

"It's that we've got to solve," Johnson said.

Delaney looked scornful. "You think you're going to solve the problem of terrorism here in this barn in a few hours when all the world's wisest men haven't been able to do anything about it in the last twenty-five years?"

"Maybe we've got the last good chance," Johnson said.

"If you have an idea maybe we

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shouldn't discuss it in front of our friend here," Chrisman said, nodding at Mohammed.

"I go back there," Mohammed said proudly, pointing toward a dark corner of the barn. The last of the beams of sunlight had disappeared, and only the darkening twilight kept the gloom from being total.

"Any solution would have to involve you," Johnson said to Mohammed.

"Some kind of solution!" Delaney said, sniffing.

"Let him talk," Chrisman said. "I like the way this man thinks." He settled back on his elbows as if to listen, but just then the door opened.

"Is all right, Mohammed?" Fatima asked from outside.

Mohammed nodded and then realizing she could not see him, said in a shaky voice, "Yes."

Another middle-easterner, one they had not seen before, came through the door with a pistol in his hand. Behind him came Fatima with a paper plate filled with sandwiches in one hand and a thermos jug in the other. "You not hunger," she said, "as so many of our people." She put the plate and the jug on the dirt floor of the barn and motioned her head at Mohammed, as she turned and went back through the doorway.

Shamefacedly avoiding the gaze of the hostages, Mohammed followed his sister through the doorway. In a few minutes he returned. The guard looked hard at him and then retreated through the door. The door closed. They could hear it bolted.

"I tell my sister nothing," Mohammed said. "I know not if she believe me."

"Hell," Delaney said, "I don't believe you."

"There was nothing to tell," Chrisman said. "Now. What's your idea?"

As if he were gauging their capacity to understand and to change, Johnson looked at the scientist sprawled back on the blanket and the young woman sitting tensely on hers, hugging her knees to her chest, and the young Palestinian standing nervously apologetic nearby. "First perhaps we should eat before the food gets any older," he said and smiled. "And maybe we can think better when we have food in our stomachs."

Delaney hadn't wanted to let Mohammed have any of the sandwiches until Chrisman commented wryly, between bites of the dry bread and cheese, that the food might be poisoned, and then she wouldn't eat until she had seen the effect on Mohammed, even after Chrisman apologized and pointed out that it wouldn't make sense to poison them when they could be disposed of just as easily in other ways, and in any case they wouldn't take the chance of poisoning one of their own. But Delaney's fears were not logical. Finally, however, they had all eaten and drunk the cool, iceless, odd-tasting water, though Delaney had spit out a mouthful when Chrisman said, "Of course the water may be drugged to put us out—I'm sorry. It's just water from an old well."

By now they were all seated on blankets, and the barn was almost completely dark. Their captors had not provided a light, and they were faceless

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voices in the dark, like children telling ghost stories late at night. "Of course we could break out of here now," Chrisman said quietly. "It's hard to believe they have enough guards to catch us in the darkness. Of course, we would have to blunder around among the trees and brush. They might have automatic weapons, and one of the terrorists might lose his head and open fire. We wouldn't know what direction to go, either. We couldn't go back down the dirt road or we'd be recaptured for sure. There'll be an almost full moon later tonight. That would help us, but it would help them, too. And there's our friend, here."

"What would you do?" Johnson asked.

"I—I—" Mohammed said, as if unable to answer.

"That's something," Johnson said.

"Of course if we decide to break out, we've got to do it in the next hour or so, while it's still dark," Chrisman said.

"I've got to go to the bathroom," Delaney said suddenly. "I can't hold it any longer."

"It's dark," Chrisman said, "and there are lots of corners."

"There also may be rats and spiders," she said.

"And snakes," Chrisman said. He seemed to take pleasure in teasing her.

"Maybe I can wait," she said.

"We have an hour," Johnson said. "We should give them time to get bored and sleepy, anyway. We can talk."

"Let's talk," Chrisman said.

"We're fortunate in a way," Johnson said. "We have a representative group: a reluctant terrorist, someone who is terrified, and a couple of reasonable people, one of whom is in a position to recommend a solution that might be considered seriously by the authorities."

"Aren't we lucky," Delaney said. Her small attempt at sarcasm was undercut by the break in her voice.

"Yes," Johnson said.

"What's your idea, Johnson?" Chrisman said lazily.

"Most of the problems with terrorism seem to be involved with the ownership of land," Johnson said. "Particularly homelands. And particularly when a piece of land is homeland to more than one people."

"Religion also seems to play a part," Chrisman said.

"Yes, but usually when it is associated with some kind of nationalistic movement. The big problem seems to be land."

"And, as Will Rogers once said," Chrisman said, "they ain't making any more."

"That's the point," Johnson said. "If I'm right, we have almost reached the stage where we can make more."

Chrisman sat up in the darkness, the hay making an audible squeak under the blanket. "Yeah."

"That's the work you're involved in, I believe," Johnson said. "You're not a regular astronaut. This sort of thing is what took you into space."

"Making land," Chrisman said. "It might work."

"I don't understand what you two are talking about!" Delaney protested.

"Me also," Mohammed said helplessly.

"Space habitats," Chrisman said. "That's what I'm into. Making places in space where people can live. Out of

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materials constructed on Earth and transported into space to be put together there for living quarters, laboratories, factories. At first, anyway. Later getting raw materials from the moon. Much later moving large asteroids into orbit around the Earth, mining them for iron and other minerals, hollowing them into habitats, maybe mobile ones containing their own gravity, air, air renewal system, farms, factories, propulsion systems. Eventually making them self-sufficient, maybe capable of carrying the inhabitants anywhere they want to go in the solar system, maybe anywhere in the galaxy."

His enthusiasm was evident, even in the darkness. It was clear that he had thought about this a great deal and even made speeches about it.

"I don't see what good that's going to do us," Delaney said. "I wouldn't live in a place like that, even if we get out of here alive."

"Nobody's asking you to, Delaney," Chrisman said. "We're going to ask Mohammed here."

"Me?" Mohammed said. In the darkness his expression could only be imagined.

"How would you like to live in a world orbiting the Earth?" Chrisman said.

"I be frightened," Mohammed said. "How I live? How I breathe?"

"Those things would be taken care of," Chrisman said. "You would be taught things. And there would be others there. Your sister. The rest of your people eventually. Anybody who wants to go."

"There be millions," Mohammed said. "You put all in space?"

"Those who want to go. The committed. The terrorists. The adventurous. Some will refuse. But think: the Palestinians protest because they say they have been cheated of their heritage and their future. If they go to live in space habitats, the future will be theirs."

"Theirs only?"

"Of course there will be others," Chrisman said. "Other dissident groups to begin with, but once it gets rolling young people of many nationalities will want their own chance in space."

"My people not know such things as space—what you say—habitats."

"The Palestinians are intelligent and well educated, and anybody who can handle explosives secretly without blowing themselves up can learn how to take the necessary precautions to live in space. It requires forethought, but this is something your people are good at. The Irish? Maybe they can learn."

"You mean we would go to the great expense of putting these living quarters into space so that terrorists could live in them?" Delaney said incredulously.

"That's the beauty of it, don't you see?" Chrisman said. "Humanity's future lies in space. It doesn't matter who goes first. It's all of us. Right now there aren't enough people who can see this clearly enough to finance it. But maybe we can get enough support by making it serve two purposes: we'll solve the terrorist problem and get the space habitats started at the same time."

"But that's rewarding the terrorists for killing people," Delaney protested.

"We can't afford that kind of thinking," Johnson said.

"It's just solving the problem," Chrisman said impatiently. He seemed

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to have adopted the idea as if it were his own. "You don't realize how much money and resources go into the business of coping with terrorism. And how close terrorism might come to destroying us all in a nuclear war if the wrong people get their hands on nuclear weapons, or somebody miscalculates. We could lose everything."

"Maybe my people not go," Mohammed said. "This space thing not be Palestine."

"There are many reasons why your people should accept a generous offer. Not the least is their pride. It would be dangerous. Some would die in accidents. There would be martyrs. But there would be peace, and a land brighter and richer than Palestine."

"Then the Jews would want one," Delaney said.

"Let them have one." Chrisman said. "Let anybody who wants a habitat have one if they can afford it or the funds can be raised somewhere. People will be too busy in space making things work to worry about old antagonisms. Just like the settlers were too busy in America. Maybe, if we all work at it, we can turn our competitive instincts toward our galactic environment rather than each other."

"There still will be problems," Johnson said.

"Oh, of course," Chrisman said. "This isn't utopia. It just gives us breathing room. And maybe it scatters humanity's seed far enough that a single accident can't wipe it out. If we can just get it done, it will mean that humanity is immortal. Or at least as immortal as the universe."

"Maybe it work," Mohammed said. For the first time he sounded hopeful.

"You think your sister would go for it?" Delaney said. For the first time she sounded hopeful, too.

"Maybe." He seemed excited now. He moved toward the door, stumbling in the darkness, and pounded on it. The noise was startling in the night. A voice outside spoke loud, harsh words in a foreign language, and Mohammed replied in the same language. The captives could make out the word "Fatima." It was repeated several times.

"Already?" Chrisman said. "At this time of night?"

"Why not?" Delaney said. She was standing. "Johnson? Are you there?"

"Yes." Johnson felt a hand touch his and cling to it for a moment.

"I'm sorry," she said. She released his hand. It was enough. She, too, had the capacity to change. She laughed. "I'm going to the bathroom while I have the chance."

The door opened. Through the doorway came the light of the nearly full moon outlining the figure of Mohammed's sister and casting a long shaft of silver across the barn floor.

"Fatima," Mohammed said confidently, "I have good idea. . . ."

The prisoners were released on a street corner in Washington, D.C. not far from a telephone booth and only half a dozen blocks from Capitol Hill. Mohammed had been persuasive, but inbred paranoia was not quickly discarded. There was much work to be done; it would take time, years perhaps.

"Do you think it will work, Johnson?" Chrisman asked, as he waited for

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Delaney to be finished with the telephone.

"I know it will," Johnson said. His eyes had the look of someone who was seeing distant visions.

"You have people here?" Chrisman asked. "You need a lift somewhere?"

"Don't worry about me," Johnson said. "But do you have a piece of paper on you?"

Chrisman looked down at his astronaut's coveralls and smiled. "I'm afraid not. As a matter of fact, I was going to borrow a quarter from you or Delaney for the telephone call."

Johnson rummaged through his pockets and came up with a quarter. "Here," he said, and when Chrisman turned to the telephone booth, he walked quickly away.

In an alley between office buildings he found an area enclosed by overflowing trash containers and large cardboard boxes. He rummaged through the containers until he found a small box, tore the flap from it, settled down behind one of the large ones, and held the flap up to a distant street light as he wrote:

"Your name is Bill Johnson. You have just helped solve the problem of political terrorism and launched humanity toward the stars, and you don't remember. You may find the newspapers filled with reports of what happened, but you will find no mention of the part you played.

"For this there are several possible explanations. . . ."

After he had finished, he propped the flap against an adjacent trash container where he would see it when he awoke, pulled his jacket tightly around him against the night's chill, and lay back to await the new day. ■

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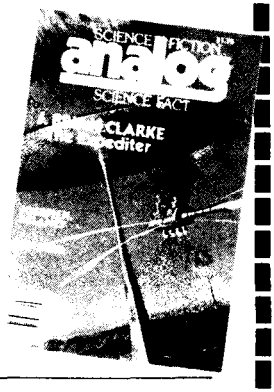

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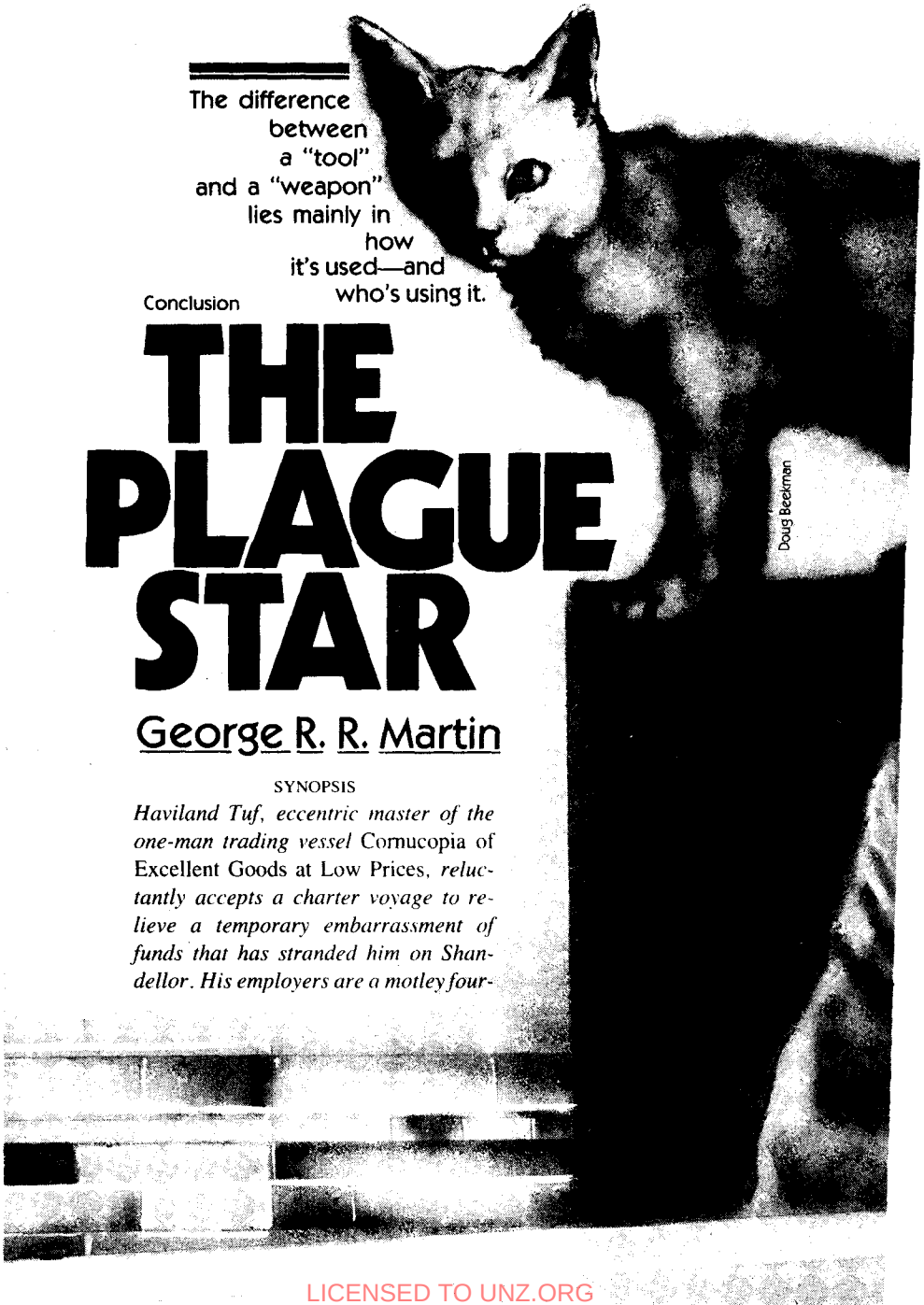
The difference between a "tool" and a "weapon" lies mainly in how it's used—and who's using it.

Conclusion

THE PLAGUE STAR



Doug Beekman

George R. R. Martin

SYNOPSIS

Haviland Tuf, eccentric master of the one-man trading vessel Cornucopia of Excellent Goods at Low Prices, *reluctantly accepts a charter voyage to relieve a temporary embarrassment of funds that has stranded him on Shandellor. His employers are a motley four-*

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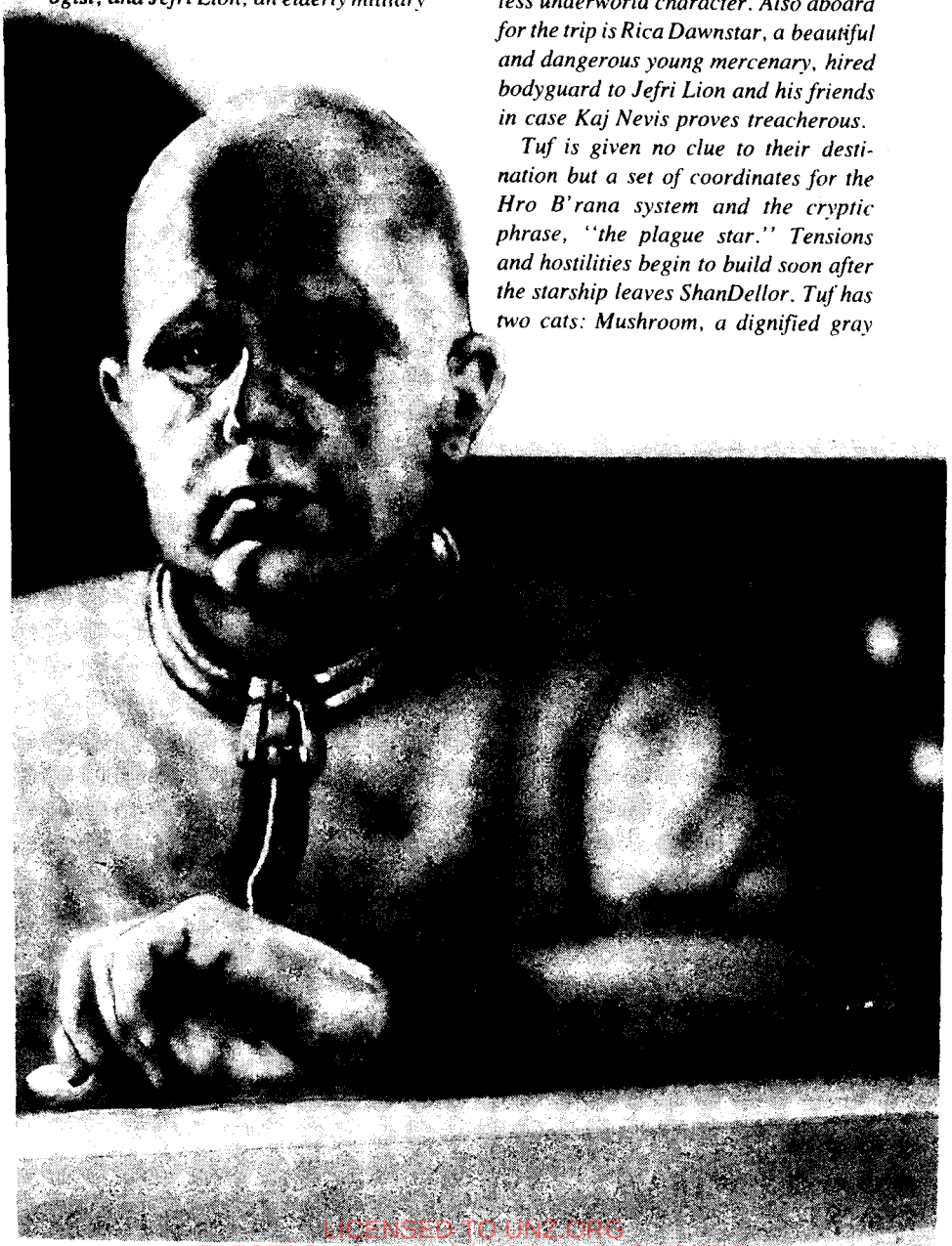
some engaged in some mysterious conspiracy. Two are academics: Celise Waan, a fat and querulous anthropologist, and Jefri Lion, an elderly military historian and retired soldier. The cyborg Anittas is a cybertech and systems expert, while Kaj Nevis is a shady, ruthless underworld character. Also aboard for the trip is Rica Dawnstar, a beautiful and dangerous young mercenary, hired bodyguard to Jefri Lion and his friends in case Kaj Nevis proves treacherous.

Tuf is given no clue to their destination but a set of coordinates for the Hro B'rana system and the cryptic phrase, "the plague star." Tensions and hostilities begin to build soon after the starship leaves ShanDellor. Tuf has two cats: Mushroom, a dignified gray



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tom, and Havoc, a younger black-and-white female. Celise Waan is allergic to cats, and the kittenish Havoc persists in stealing jewelry, pencils, and anything else not fastened down for use as cat toys.

Rica Dawnstar approaches Tuf one night and suggests that the two of them, the two "hirelings," jointly demand full shares of the bonanza the others clearly expect to find at the plague star, but Tuf declines her offer.

As the voyage continues Celise Waan complains constantly about her accommodations, her companions, and the cats. Tuf, a vegetarian, has been feeding his passengers a variety of meatless dishes. One night Celise Waan demands meat. Tuf admits he carries "some small poor quantity" of meat, and offers it to the anthropologist for the story of the plague star.

Waan tells him that the plague star is a legend among the peoples of Hro B'rana, a bright light that appears in the heavens every third generation, bringing with it terrible plagues and pestilence. Jefri Lion, when told the legend, theorized that the plague star might actually be a still-operational biowar seedship of the long-defunct Ecological Engineering corps, left over from a war a thousand years past. Anittas was enlisted to probe the workings of their find, and Kaj Nevis to dispose of it profitably through less-than-licit channels.

Tuf, satisfied, fulfills his side of the bargain by providing Celise Waan with several cans of cat food.

The Cornucopia*'s arrival at the plague star is traumatic. Lion's theory is correct: an EEC seedship, thirty kilometers long, and still at least partly operational, awaits them. But while the conspirators are celebrating, the seedship opens communications, identifying itself as the* Ark *and demanding that the* Cornucopia *identify itself or be destroyed. Tuf's efforts to reply come to naught, and it becomes clear he is conversing with a series of tapes and an implacable, thousand-year-old defense program. Jefri Lion claims to have a chip encoded with Federal Empire ID codes, but when he goes for it, he finds it gone. Before they can retreat, the* Ark *fires upon the* Cornucopia*, crippling their stardrive and life-support.*

Haviland Tuf announces that, while they cannot approach and dock without being destroyed, he has a plan to get them aboard. He produces an antique alien spacesuit; a giant, heavily armored, four-armed battlesuit. The battlesuit's vastly augmented exoskeletal strength will get them through the Ark*'s emergency locks, Tuf suggests, and he theorizes that the ship will not fire on such a relatively small target.*

Before the plan can be put in motion, however, Kaj Nevis makes his move, producing a vibroknife and appropriating the battlesuit for himself. When Rica Dawnstar is called upon to stop him, she declines; unable to make a deal with Tuf, she has made one with Nevis instead. Nevis, accompanied by Dawnstar and Anittas in spacesuits and airjets, depart the Cornucopia *after Nevis has destroyed one of Tuf's two remaining suits.*

Left to die aboard the Cornucopia *with Celise Waan and Jefri Lion, Tuf is suffering Waan's wrath when Havoc is spied playing with a ring. Tuf, suddenly inspired, searches beneath his*

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consoles and finds a number of lost cat toys, including the missing computer chip of Federal Empire codes. The Ark*'s defense programming accepts the identification and Tuf uses the* Cornucopia*'s maneuvering engines to bring them down on the seedship's vast landing deck among a number of derelict ships.*

Fearing that the atmosphere of the Ark *might be contaminated by disease as a secondary defense, Tuf dons their only pressure suit and begins a search of the derelicts around them to find suits for Waan and Lion. He succeeds, but when he returns, he finds Mushroom out on the deck, unprotected. Celise Waan explains that she got tired of waiting for Tuf and cycled Mushroom through the* Cornucopia*'s airlock to see if the air was safe.*

Meanwhile, Nevis, Dawnstar, and Anittas have penetrated one of Ark*'s outer airlocks, but cannot get through the inner door. Anittas is reluctant to remove his suit in order to interface with the computer lock and open the door, but Nevis, impatient, uses the battlesuit's vast strength to rip the helmet off the cybertech. Anittas opens the way for them, but Nevis's obvious ruthlessness and the power of his battlesuit gives Rica Dawnstar second thoughts about her new alliance, and she flees.*

Jefri Lion leads his party to a ship's armory. As Lion and Waan argue, however, Tuf is tending Mushroom, who is now sick and in great pain. Finally Tuf breaks the cat's neck to end its agony, and wanders away from his companions, unnoticed, Mushroom's body cradled in his arms.

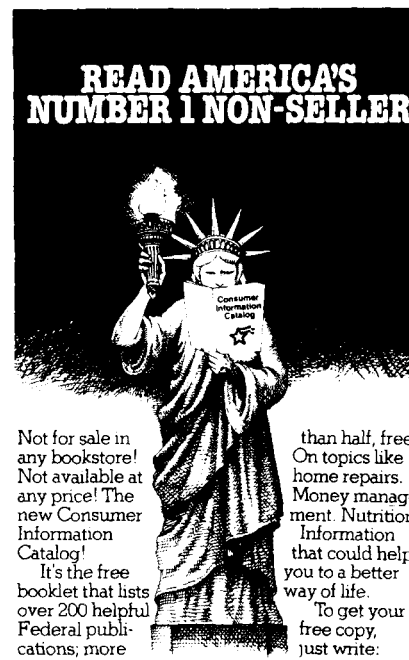
Anittas too has grown ill. When he collapses, Nevis carries him to a computer substation, where the cybertech interfaces with the Ark*'s computers.*

Rica Dawnstar, driving a three-wheeled cart she's found, begins following a trace light in the floor that seems to be leading her somewhere.

Jefri Lion and Celise Waan, now heavily armed, have an argument. Lion stalks off while Waan sits down to pout.

And Haviland Tuf, carrying a dead cat, is stalking the corridors of the Ark *alone and unarmed.*

Haviland Tuf had come to a strange place.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He had wandered down endless dark, narrow corridors, carrying Mushroom's limp body, hardly thinking, without plan or destination, and finally he had emerged from one such corridor into what seemed to be a large cavern. The walls fell away on all sides of him; he was swallowed by empty darkness, and his bootsteps sent echoes ringing off distant walls. There were sounds in the dark; a low humming, at the threshold of hearing, and a louder sound, a liquid sound, like the ebb and flow of some endless underground ocean. But he was not underground, Haviland Tuf reminded himself. He was lost aboard an ancient starship called *Ark*, and surrounded by villains, and Mushroom was dead by his own hand.

He walked on. How long he could not say. His footsteps rang. The floor was level and bare and seemed to go on forever. Finally he walked right into something in the dark. He was moving slowly, so he was not hurt, but he dropped Mushroom in the collision. He groped ahead, tried to determine what sort of object had stopped him, but it was hard to tell through the fabric of his gloves. It was large and curved.

That was when the lights came on.

For Haviland Tuf, there was no explosion of light; what illumination existed in this place was dim, murky, subdued. As it shown down from above, it cast ominous black shadows everywhere, and gave the lighted areas a curious greenish cast, as if they were covered with some radiant moss.

Tuf gazed about. It was more a tunnel than a cavern, perhaps. He had walked all the way across it, a distance of at least a kilometer, he judged. But its breadth was nothing to its length; it must run the full length of the ship, along its major axis, for it seemed to vanish into dimness in both directions. The ceiling above was a shroud of green shadows; high, high overhead, echoes rang off its dimly-seen curves. There were machines, a good many machines; computer substations built into the walls, strange devices the like of which Haviland Tuf had never seen, flat worktables with waldoes and microhands built into them. Yet the main feature of this huge, echoing shaft was the vats.

Everywhere there were vats. They lined both walls as far as the eye could see in either direction, and a few even bulged down from the ceiling. Some of the vats were immense, their swollen translucent walls large enough to contain the *Cornucopia*. Elsewhere they were cells the size of a man's hand, thousands of them, ascending from floor to ceiling like plastic honeycombs. The computers and work-stations dwindled into insignificance beside them, small details easily overlooked. And now Haviland Tuf discerned the source of the liquid sound he had heard. Most of the vats were empty, he saw through the greenish gloom, but a few—one here, one there, two further on—a few seemed to be full of colored fluids, bubbling, or stirred by the feeble motions of half-seen shapes within.

Haviland Tuf regarded the vista before him for a long time, its scale making him feel very small. Yet finally he turned away, and bent to pick up Mushroom once again. As he knelt, he saw what he had walked into in the dark: a vat, a medium-large one, its transparent walls curving away from him. This vat

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was full of a thick, murky yellowish liquid, shot through with moving swirls of red. Tuf heard a faint gurgling, and felt a slight vibration, as if something were stirring inside. He leaned closer, peered in, and then craned his head up.

Within, floating, unborn and yet alive, the tyrannosaur stared down at him.

In the circuit there was no pain. In the circuit he had no body. In the circuit he was mind, pure sweet white mind, and he was part of something vast and powerful and infinitely greater than himself, greater than any of them; in the circuit he was more than human, more than cyborg, more than mere machine. In the circuit he was something like a god. Time was nothing in the circuit; he was as swift as thought, as swift as silicon circuitry opening and closing, as swift as the messages that raced along superconductive tendons, as swift as the flash of microlasers weaving their invisible webs in the central matrix. In the circuit, he had a thousand ears and a thousand eyes and a thousand hands to ball into fists and strike with; in the circuit he could be everywhere at once.

He was Anittas. He was *Ark*. He was cybertech. He was more than five hundred satellite stations and monitors, he was twenty Imperial 7400s ruling the twenty sectors of the ship from twenty scattered substations, he was Battlemaster, Codebreaker, Astrogator, Drive Doctor, Medcenter, Ship's Log, Librarian, BioLibrarian, Microsurgeon, Clonetender, Maintenance and Repair, Communications, Defense, he was all the hardware and all the software and all the back-up systems and all secondary and tertiary back-ups, and he was twelve hundred years old and thirty kilometers long and the heart of him was the central matrix, barely two meters square and all but infinite in size. He touched here and there and everywhere and moved on, his consciousness racing down the circuits, branching, dancing, riding on the lasers. Knowledge raced through him in a torrent, like a great river running wild, with all the cool steady sweet white power of a high voltage cable. He was *Ark*. He was Anittas. And he was dying.

Down deep in his bowels, down in the ship's intestines, down at substation seventeen by airlock nine, Anittas let his silvermetal eyes track and focus on Kaj Nevis. He smiled. On his half-human face, it was a grotesque expression. His teeth were chrome steel. "You fool," he said to Nevis.

The battlesuit took one threatening step closer. A pincer raised itself with a grinding, metallic sound, opened and closed. "WATCH YOUR MOUTH."

"Fool I said and fool it is," Anittas told him. His laughter was a horrible sound: it was full of pain and metallic echoes, and his lips were bleeding freely, leaving wet red smears on those shining silver teeth. "You killed me, Nevis, and for nothing, for impatience, and I could have given it all to you. It's empty, Nevis. The ship is empty, they're all dead. And the system is empty too. I'm alone in here. No other mind in the circuit. It's an idiot, Kaj Nevis. *The Ark* is an idiot giant. They were afraid, those Earth Imperials. They'd achieved true Artifical Intelligence, oh yes, they had their great AI warships, their robot fleets, but the AIs had minds of their

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own, and there were incidents, it's in the histories, there was Kandabaer and the action off Lear and the revolt of *Alecto* and *Golem*. The seedships were too powerful, they knew that as they built them. The *Ark* had duties for two hundred, strategists and scientists and eco-engineers and crew and officers, and she could carry more than a thousand soldiers too, and feed all of them, and operate at full capacity, and lay waste to *worlds*, oh yes, and everything worked through the system, Nevis, but it's a safe system, a big system, a sophisticated system, a system that can repair itself and defend itself and do a thousand things at once—if you tell it to. The two hundred crewmen made it efficient, but you could run it with only one, Nevis. Not efficiently, no, not at anything near full capacity, no, but you could do it. It can't run itself, it's got no mind, no AI, it waits for orders, but one man can tell it what to do. One man! I could have done it easily. But Kaj Nevis got impatient and killed me."

Nevis moved still closer. "YOU DON'T SOUND DEAD TO ME," he said, opening and closing his pincer with a sudden menacing snap.

"But I am," said Anittas. "I am sucking power from the system, boosting my cyberhalf, giving myself back a speech capacity. But I'm dying all the while. Plagues, Nevis. The ship was horribly undermanned in its last days, only thirty-two left, and there was an attack, a Hruun attack. They broke the code, opened the dome, landed, they were storming up the halls, more than a hundred of them. They were winning, threatening to take the ship. The defenders fought them every step of the way. They sealed off whole sectors of the *Ark*, evacuated all the air, turned off all the power. They got a few that way. They set up ambushes, fought them meter for meter, there are still places that are battle-scarred, dysfunctional, beyond the *Ark*'s repair capacities. They let loose plague and pestilence and parasite, and from their vats they summoned their pet nightmares, and they fought, and died, and won. In the end all the Hruun were dead. And you know what, Kaj Nevis? All but four of the defenders were dead as well. One of those was grievously wounded, two others sick, and the last was dead inside. Would you like to know their names? No, I thought not. You have no curiosity, Kaj Nevis. It is no matter. Tuf will want to know, as will the ancient Lion."

"TUF? LION? WHAT ARE YOU TALKING ABOUT? THEY'RE DEAD, BOTH OF THEM."

"Incorrect," Anittas said. "They are both aboard even now. Lion has found the armory. He's a walking arsenal, and he's coming for you. Tuf has found something even more important. Rica Dawnstar is following the silver trace to the main control room, the captain's chair. You see, Kaj Nevis, the gang's all here, and I have woken up every part of the *Ark* that remains functional, and I am leading them all by the hand."

"STOP IT, THEN," Nevis commanded. He did not hesitate. The great metal pincer reached out and embraced Anittas about his biometal throat. Black sweat oozed down onto the pincer's serrated blade. "STOP THEM RIGHT NOW."

"I have not completed my story, Kaj

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Nevis," the cybertech said. His mouth was a smear of blood. "The last Imperials, Nevis, they knew they could not go on. They shut down the ship, gave it up to vacuum and silence and the void, so much of it. They made it go derelict. Yet not entirely, you see. They feared another attack, by the Hruun or perhaps, in time, others yet unknown. So they told the *Ark* to defend itself. They armed the plasma cannon and external lasers and kept the defense sphere functional, as we learned to our sorrow. And they programmed the ship to take a terrible vengeance for them, to return again and again and again to Hro B'rana, whence the Hruun had come, and to deliver its gift of plague and pestilence and death. To guard against the Hruun's building up immunity, they subjected their plague tanks to constant radiation, to encourage endless mutation, and they established a program for automatic genetic manipulation to fashion ever newer and more deadly viruses."

"I DON'T GIVE A DAMN," Kaj Nevis said. "HAVE YOU STOPPED THE OTHERS? CAN YOU KILL THEM? I WARN YOU, DO IT NOW OR YOU'RE DEAD."

"I am dead anyway, Kaj Nevis," Anittas said, "I've told you that. The plagues. They left a secondary defense in place. Should the ship be breached once again, the *Ark* was programmed to wake itself, to fill the corridors with atmosphere, oh yes, but an atmosphere tainted by a dozen diifferent disease vectors. The plague tanks have been churning and boiling for a thousand standard years, Kaj Nevis, mutating again and again. There is no name for what I have contracted. Some kind of spore, I think. There are antigens, medicines, vaccines, the *Ark* has been manufacturing those as well, but it's too late for me, too late by far. I breathed it in, and it's eating my biohalf alive. My cyberhalf is inedible. I could have given us this ship, Kaj Nevis. Together we might have had the power of a god. Instead we die."

"*YOU* DIE," Nevis corrected. "AND THE SHIP IS MINE."

"I think not. I have kicked the idiot giant soundly, Kaj Nevis, and it is awake again. Still an idiot, oh yes, but awake, and ready for orders you have neither the knowledge nor the capacity to give. I am leading Jefri Lion straight here, and Rica Dawnstar is ascending toward central control even now. And more—"

"NO MORE," Nevis said curtly. The pincer crunched through metal and bone and took the cybertech's head clean off with a single swift snap. The head bounced off Anittas's chest, hit the floor, and rolled. Blood jetted from the neck, and a thick protruding cable gave a final futile hiss and threw off a blue-white spark before the body sagged against the computer console. Kaj Nevis drew back his arm and swung, smashing the console again and again, until it was a ruin and hundreds of shards of plastic and metal were scattered over the floor.

There was a high thin whirring sound.

Kaj Nevis turned, faceplate glowing a bright bloody red, searching for the source.

On the floor. The head was looking at him. The eyes, the shiny silver eyes, tracked and focused. The mouth split into a wet grin. "And more, Kaj Nevis," the head said to him, "I have activated

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the final line of defense programmed by those last Imperials. The stasis field is down. The nightmares are waking up now. The guardians are about to come forth and destroy you."

"DAMN YOU!" Nevis shouted. He set a huge, flat foot atop the cybertech's head, and brought down all his weight. Steel and bone alike crunched under the impact, and Nevis worked his foot back and forth, back and forth, grinding away until there was nothing beneath his heel but a red-gray paste spotted by flakes of white and silver.

And then, at last, he had silence.

For a long ways, two kilometers or more, the six traces in the floor ran parallel, although only the silver was alive and glowing. The red broke away first, veering off to the right at a junction. The purple terminated a kilometer farther on, at a wide door that proved to be the entrance to a spotless automated kitchen-messhall complex. Rica Dawnstar was tempted to pause and explore a bit more, but the silver trace was throbbing and the overhead lights were going out one by one, urging her onward, down the main way.

Finally she came to the end. The broad corridor she was following curved gradually to the left and met another corridor just as grand. Their terminus was a huge wheel from which a half-dozen lesser hallways branched off like spokes. The ceiling was high above her. Looking up, Rica spotted at least three other levels, connected with catwalks, bridges, and great circling balconies. At the hub of the wheel was a single large shaft that ascended from floor to ceiling; an elevator, clearly.

The blue trace followed one spoke, the yellow a second, the green a third. The shining silver guideway led straight to the elevator doors. The doors opened at her approach. Rica drove her scooter right to the base of the shaft, stopped, dismounted, hesitated. The elevator beckoned. But it looked awfully enclosed in there.

She hesitated too long.

All the lights went out.

There was only the silver trace, a single thin line like a finger, pointing straight ahead. And the elevator itself, its lights still blazing.

Rica Dawnstar frowned, drew her needler, and stepped inside. "Up, please," she announced. The doors closed and the elevator began to ascend.

Jefri Lion walked with a spring in his step, despite the weight of the weapons he was carrying. He felt even better since leaving Celise Waan behind; that woman was nothing but a nuisance anyway, and he doubted that she'd be of much use in a skirmish. He had considered the possibility of stealth, and rejected it. He was not afraid of Kaj Nevis and his battlesuit. Oh, it was formidably armored, he had no doubt of that, but after all, it was of alien manufacture, and Lion was armed with the deadliest weaponry of the Earth Imperials, the height of the technological and military prowess of the Federal Empire of Old Earth as it had been before the Collapse. He'd never even heard of the Unquish; what kind of armigers could they be? No doubt some obscure Hrangan slave-race. He would deal with Nevis in short order if he found him, and with that treacherous Rica Dawnstar too, her and

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that stupid needler, he'd like to see how a needler could possibly stand up against a plasma cannon, yes, he'd like to see that.

Lion wondered what plans Nevis and his cohorts were making for the *Ark*. Something illegal and immoral, no doubt. Well, it made no matter, because he was going to take this ship, he, Jefri Lion, Associate Scholar in Military History at the ShanDellor Center, and one-time Second Tactical Analyst of the Third Wing of Skaeglay's Volunteers, he was going to capture an EEC seedship, perhaps with Tuf's help if he could find Tuf, but he would do it in any event, and afterward there would be no selling of this treasure for crass personal gain, no, he would take the ship all the way to Avalon, to the great Academy of Human Knowledge, and turn it over to them with the proviso that he remain in charge of its study. It was a project that would last him the rest of his life, and when it ended Jefri Lion, scholar and warrior, would be spoken of in the same breath as Kleronomas himself, who had made the Academy what it was.

Lion strode down the center of the corridor with his head thrown back, following the orange trace, and as he walked he began to whistle a jaunty marching tune that he had learned in Skaeglay's Volunteers a good forty years ago. He whistled and walked, walked and whistled.

Until the trace died out.

Celise Waan sat on the deck for a long time, her arms crossed tightly against her breasts, her face set in a petulant frown. She sat until the sound of Lion's footsteps had faded away entirely. She sat and brooded on all the insults and wrongs she had been forced to endure. They were all impossible, every one of them, she should have known better than to throw in her lot with such an unpromising and disrespectful crew. Anittas was more machine than man, Rica Dawnstar was an insolent little wretch, Kaj Nevis was no better than a common criminal, and Haviland Tuf was just unspeakable. Even Jefri Lion, her colleague, had proved unreliable in the end. The plague star was *her* discovery, and she had let them in on it, and what had it gotten her? Discomfort, rudeness, and finally abandonment. Well, Celise Waan didn't intend to stand for it any more. She had decided not to share the ship with any of them. It was her find, and she would go back to Shandicity and claim it under the salvage laws of ShanDellor, as was her right, and if any of her wretched companions had any complaints, they would have to take her to litigation. Meanwhile, she didn't intend to talk to any of them, not ever again.

Her rear was getting sore and her legs had begun to fall asleep. She had been sitting in one position for a long time. Her back ached too, and she was hungry. She wondered if there was any place she could get a decent meal aboard this derelict. Perhaps there was; the computers seemed to be working, and the defense systems, and even the lights; so perhaps the commissary was functioning as well. She got up and decided to go see.

It was obvious to Haviland Tuf that something was happening.

The noise level in the great shaft was

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rising, slowly but appreciably. He could make out a low humming sound quite distinctly, and those gurgling sounds were more noticeable as well. And in the tyrannosaur vat, the suspension fluid seemed to be thinning and changing colors; the red swirls had faded or been sucked away, and the yellow liquid grew more transparent with every passing moment. Tuf watched a waldo unfold from one side of the vat. It appeared as though it was giving the reptile an injection, though Tuf had difficulty observing the details, since the lighting was poor in any event.

Haviland Tuf decided on a strategic retreat. He backed away from the dinosaur vat, and began to walk down the shaft. After he had come only a short way, he came upon one of the computer stations and work areas he had observed. Tuf paused.

He had experienced little difficulty discerning the nature and purpose of this chamber he had chanced upon. The *Ark* had at its heart a vast cell library, containing tissue samples from literally millions of different kinds of plant and animal and viral life forms from an uncounted number of worlds, or so Jefri Lion had informed him. These samples were cloned, as the ship's tacticians and eco-engineers deemed appropriate, and so the *Ark* and its lost sister ships could send forth disease to decimate a world's population, insects to devastate its crops, fast-breeding armies of small animals to wreak havoc on the ecology and food chain, or even terrible alien predators to strike fear into the heart of the enemy. Yet everything began with the cloning.

Tuf had found the cloning room. The work areas included equipment obviously intended for complex microsurgery, and the vats were undoubtedly where the cell samples were tended and grown to maturity. Lion had told him about the stasis field as well, that vanished secret of the Earth Imperials, a field that could literally warp the fabric of time itself, albeit only in a small area and at vast cost in energy. That way the clones could be brought to maturity in hours; or held, unchanging and alive, for millennia.

Haviland Tuf considered the work area, the computer station, and Mushroom, whose small body he still carried.

Cloning began with a single cell.

The techniques were no doubt stored in the computer. Perhaps there was even an instruction program. "Indeed," Haviland Tuf announced to himself. It seemed quite logical. He was no cybertech, to be sure, but he was an intelligent man who had operated various types of computer systems for virtually his entire lifespan.

Haviland Tuf stepped up to the work station, deposited Mushroom gently beneath the hood of the microscreen, and turned on the computer console. He could make no sense of the commands at first, yet he persisted. After a few minutes he was intent on his labors.

So intent that he did not notice the loud gurgling sound behind him when the thin yellow fluid in the dinosaur vat began to drain away.

Kaj Nevis smashed his way out of the system substation looking for something to kill.

He was angry. Angry at himself for being impatient and unthinking. Anittas could have been useful; Nevis just

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hadn't considered the possibility of contagion in the ship's air. The damn cybertech would have had to be killed eventually, of course, but that would not have been difficult. And now everything was falling apart. Nevis felt secure in the battlesuit, but still uneasy. He didn't like hearing that Tuf and the others had somehow gotten aboard. Tuf knew more about this damn suit than he did, after all; maybe he knew its weakness.

Kaj Nevis had already pinpointed one of those weaknesses himself. His air supply was running low. A modern pressure suit, like the one Tuf was wearing, included an airpac. The bacteria infused in its filters turned carbon dioxide into oxygen as fast a human being could turn oxygen into carbon dioxide, so there was never any danger of running out of air unless the damn bugs went and died on you. But this battlesuit was primitive; it carried a large but finite supply of air in those four huge tanks on its back. And the gauge in his helmet, if he was reading it correctly, indicated that one of those tanks was nearly empty. That still left three, which ought to give him more than enough time to get rid of the rest of them, if only he could find them. Still, it made Nevis uneasy. He was surrounded by perfectly breathable air, to be sure, but he was damned if he was going to crack his helmet after what had happened to the cybertech. The organic part of Anittas's body had decayed faster than Nevis would have believed, and the black goop that had eaten up the cybertech inside was as loathsome a sight as Kaj had ever seen, in a life that had featured lots of loathsome sights. He'd sooner suffocate, Kaj Nevis decided.

But there was no danger of that. If the damned *Ark* could be contaminated, it could be cleansed too. He'd find the control room and figure out how to do it. Even one clean sector would be enough. Of course, Anittas had said that Rica Dawnstar was already at the control room, but that did not phase him. In fact, he was kind of looking forward to that reunion.

He chose a direction at random and set off, his armored steps pounding against the deck. So let them hear him. So what did he care. He *liked* this suit.

Rica Dawnstar sprawled in the captain's chair and surveyed the readouts she had projected on the main telescreen. Well padded, large, covered with comfortable old plastic, the chair felt like a throne. It made a good place to rest. The trouble was, you really couldn't do anything *but* rest from there. The bridge had obviously been designed so that the captain sat in his throne and gave orders, and the other officers—there were nine other work stations on the upper bridge, twelve more in the lower-level control pit—did all the actual programming and punching of buttons. Lacking the foresight to have come aboard with nine flunkies, Rica was forced to move back and forth across the bridge, from one station to another, to try and get the *Ark* up and running again.

It took her a while, it was tedious work, and when she entered commands from the wrong substation, nothing happened. But slowly, step by step, she was figuring it all out. At least she felt as though she was making progress.

And she was secure. That had been

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her first objective, locking that elevator so nobody else could come up and surprise her. As long as she was here and they were down there, Rica Dawnstar held the trump card. Every sector of the ship had its own substation, and every specialized function, from defense to cloning to propulsion to data storage, had its own sub-nexus and command post, but from up here she could oversee all of them, and countermand any command that anybody else might try and enter. If she noticed. And if she could figure out how. That was the problem. She could only man one station at a time, and she could only get things done when she figured out the proper sequence of commands. She was doing it, yes, by trial and error, but that was a lengthy and cumbersome progress.

She slumped back in her padded throne and watched the readouts, feeling proud of herself on several counts. She had managed to elicit a shipwide status check, it seemed. The *Ark* had already given her a full damage report on those sectors and systems that had been inoperative for a thousand years, waiting for repairs beyond the ship's capacities. Now it was telling her what programming was presently engaged.

The bio-defense listing was especially impressive, in a frightening sort of way. It went on and on. Rica had never heard of three-quarters of the diseases that had been unleashed to greet them, but they sounded unpleasant in the extreme. Anittas was no doubt one with the great program beyond the universe by now. Obviously, her next objective should be to try and seal off the bridge from the rest of the ship, irradiate and disinfect and try to see if she could get some uncontaminated air in here. Otherwise her suit was going to start getting pretty gamey in a day or two.

Up on the telescreen, it read:

BIO-DEFENSE PHASE ONE
(MICRO)
REPORT COMPLETE
BIO-DEFENSE PHASE TWO
(MACRO)
REPORT COMMENCING

Rica frowned. Macro? What the hell did that mean? Big plagues?

STAND-BY BIO-WEAPONS AT READY: 47

the screen told her, and it followed that cryptic bit of information with a lengthy list of species numbers. It was a boring list; Rica slumped back in the captain's throne again. When the list ended, more messages rolled across the screen.

ALL CLONING PROCEDURES COMPLETE
MALFUNCTIONS IN VATS: 671, 3312, 3379
MALFUNCTIONS ABORTED
STASIS FIELDS TERMINATED
RELEASE CYCLE COMMENCING

Rica Dawnstar wasn't sure she liked the sound of that. Release cycle, she thought. What was it releasing? On the one hand, Kaj Nevis was still out there; if this second phase defense could discomfort, distract, or dispose of him, that was all to her benefit. On the other hand, she already faced the task of getting rid of all these plagues, she didn't need any more problems. The reports began to flash by more quickly.

SPECIES # 22-743-88639-04090
HOMEWORLD: VILKAKIS
COMMON NAME: HOODED DRACULA

it said. Rica sat up straight. She'd heard

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of Vilkakis and its hodded draculas. Nasty things. Some kind of flying nocturnal bloodsucker, she seemed to recall. Dim-witted, but incredibly sensitive to sound, and insanely aggressive. The message flicked out. In its place appeared a single line.

INITIATING RELEASE

the screen told her. It held a moment and was replaced by a shorter line, a single word that flashed once, twice, three times and then was gone:

RELEASED

Now, could a hooded dracula possibly have Naj Nevis for lunch? Unlikely, Rica thought, not so long as he wore that stupid armored suit. "Great," she said aloud. She didn't have a battlesuit, which meant that the *Ark* was creating problems for her, not for Nevis.

SPECIES # 13-612-71425-88812
HOMEWORLD: ABBATOIR
COMMON NAME: HELLKITTENS

Rica had no idea what a hellkitten was, but she didn't especially want to find out. She had heard of Abbatoir, of course. A quaint little world that had eaten three different colonizing parties; its life forms were supposed to be uniformly unpleasant. Unpleasant enough to chew through Nevis's battlesuit, though? That seemed doubtful.

INITIATING RELEASE

How many things was the ship going to belch forth? Forty some odd, she recalled. "Terrific," she said dourly. Fill up the ship with forty-plus hungry monsters, any one of them sufficient to lunch on her mother's favorite daughter. No, this wouldn't do, not at all. Rica stood up and surveyed the bridge. So where did she have to go to put an end to this nonsense?

RELEASED

Rica vaulted over the captain's chair, strode briskly back to the area she'd pegged as the defense command station, and told it to cancel its current programming.

SPECIES # 76-102-95994-12965
HOMEWORLD: JAYDEN TWO
COMMON NAME: WALKING-WEB

Lights flashed in front of her, and the small telescreen on the console told her that the *Ark*'s external defense sphere was down. But up on the main screen, the parade went on.

INITIATING RELEASE

Rica uncorked a string of curses. Her fingers moved swiftly over the console, trying to tell the system that it wasn't the external defenses she wanted dropped, it was bio-defense phase two. The machine didn't seem to understand her.

RELEASED

Finally she got a response from the board. It told her she was at the wrong console. She scowled and glanced around. Of course. This was external defense, weapons systems. There had to be some kind of bio-control station too.

SPECIES # 54-749-37377-84921
HOMEWORLD: PSC92, TSC749, UNNAMED
COMMON NAME: ROLLERAM

Rica moved to the next station.

INITIATING RELEASE

The system responded to her cancel demand with a baffled query. No active program on this subsystem.

RELEASED

Four, Rica thought sourly. "That's enough," she said loudly. She stepped over to the next station, punched in a cancel, moved on without waiting to see

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if there was an effect, paused at another console to enter another cancel, moved on.

SPECIES # 67-001-00342-10078
HOMEWORLD: EARTH (EXTINCT)
COMMON NAME:
TYRANNOSAURUS REX

She ran now. Run, cancel, run, cancel, run, cancel.

INITIATING RELEASE

She made a circuit of the entire bridge, as quickly as she could. By the time she was done, she wasn't even certain which command, at which station, had done the trick. But up on the screen the message read:

RELEASE CYCLE TERMINATED
BIO-WEAPONS ABORTED: 3
BIO-WEAPONS RELEASED: 5
STAND-BY BIO-WEAPONS AT READY: 39
BIO-DEFENSE PHASE TWO (MACRO)
REPORT COMPLETE

Rica Dawnstar stood with her hands on her hips, frowning. Five loose. That wasn't too bad. She thought she'd managed to catch it after four, but she must have been a split-second too late. Oh, well. What the hell was a Tyrannosaurus Rex anyway?

At least there was no one out there but Nevis.

Without the trace to guide him, Jefri Lion had wasted no time getting lost in the maze of interconnected corridors. Finally he had adopted a simple policy; choose the wider corridors over the narrower, turn right where the passages were of the same size, go down whenever possible. It seemed to work. In no time at all, he heard a noise.

He flattened himself against a wall, although the attempt at concealment was somewhat compromised by the ungainly bulk of the plasma cannon on his back. He listened. Yes, definitely, a noise. Up ahead of him. Footsteps. *Loud* footsteps, though at some distance, but coming his way. Kaj Nevis in his battlesuit.

Smiling to himself with satisfaction, Jefri Lion unslung the plasma cannon and began to erect its tripod.

The tyrannosaur roared.

It was, thought Haviland Tuf, a thoroughly frightening sound. He pressed his lips firmly together in annoyance and squirmed back another half-meter into his niche. He was decidedly uncomfortable. Tuf was a big man, and there was very little room down here. He sat with his legs jammed under each other awkwardly, his back bent over in a painful manner, and his head bumping against the work station above. Yet he was not ungrateful. It was a small niche, true, but it had given him a place to seek shelter. Fortunately, he had been deft enough to attain that shelter. He was fortunate, also, in that the work station, with its waldos and microscanner and computer terminal, rested upon a heavy, thick metal table that extruded itself from floor and wall, and not simply a flimsy item of furniture to be easily brushed aside.

Nonetheless, Haviland Tuf was not entirely pleased with himself. He felt foolish; his dignity had been decisively compromised. No doubt his ability to concentrate on the task at hand was, in its own way, commendable. Still, that degree of concentration might be con-

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sidered a liability when it allowed a seven-meter tall carnivorous reptile to sneak up on one.

The tyrannosaur roared again. Tuf could feel the work station vibrate overhead. The dinosaur's massive head appeared about two meters in front of his face, as the beast leaned over, counterbalanced by its great tail, and tried to get in at him. Fortunately its head was too large and the niche too small. The reptile pulled out and screamed its frustration; echoes rebounded all up and down the central cloning chamber. Its tail lashed around and smashed into the work station; the sheltering table shook to the impact, something shattered up above, and Tuf winced.

"Go away," he said as firmly as he could. He rested his hands atop his paunch and attempted to look stern.

The tyrannosaur paid him no heed.

The tail came down once more.

When she first caught a flicker of movement out of the corner of her eye, Celise Waan squeaked in panic.

She backpedaled and whirled to face—to face what? There was nothing there. But she had been certain that she's seen something, up near that open door. What, though? Nervously, she unholstered her dart-pistol. She'd abandoned the laser rifle quite a distance back. It was cumbersome and heavy, and the effort of lugging it around had tired her out. Besides, she doubted that she'd be able to hit anything with it. The pistol was much preferable, in her view. As Jefri Lion had explained it, it threw explosive plastic darts, so she would not actually have to score a hit, just come close.

Warily, she moved toward the open door. She paused to one side of it, raised her pistol high, thumbed off the safety, and then peered quickly into the room.

Nothing.

It was some kind of storage room, she saw, full of plasti-sealed equipment piled high on floater skids. She glanced around uneasily. Had she imagined it, then? But as she was about to turn away, she saw it once more, a tiny darting shape that appeared on the periphery of her vision and vanished before she could quite get a clear look at it.

But this time she had seen where it had gone. She hurried after it, feeling bolder now; it had, after all, been quite small.

She had it cornered, she saw when she rounded the looming equipment skid. But what was it? Celise Waan moved closer, gun at the ready.

It was a cat.

It stared at her steadily, its tail flicking back and forth. It was kind of a funny cat. Very small. A kitten, really. It was pale white, with vivid scarlet stripes, an oversized head, and astonishing lambent crimson eyes.

Another cat, thought Celise Waan. That was all she needed: another cat.

It hissed at her.

She drew back, a little startled. Tuf's cats hissed at her from time to time, especially the nasty black-and-white one, but not like *that*. That hiss was almost, well, reptilian. Chilling, somehow. And its tongue . . . it seemed to have a very long, very peculiar tongue.

It hissed again.

"Here, kitty," she called. "Here, kitty."

It stared at her, unblinking, cold,

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haughty. Then it drew itself back and spat at her. The spittle struck her square in the center of her faceplate. It was thick greenish stuff, and it obscured her vision for a moment until she wiped it away with the back of her arm.

Celise Waan decided that she'd had enough of cats. "Nice kitty," she said, "come here, kitty. I've got a present for you."

It hissed again, drew back to spit.

Celise Waan grunted and blew it to hell.

The plasma cannon would dispose of Kaj Nevis handsomely; on that score Jefri Lion had no doubt. The strength of the armor on that alien battlesuit was an unknown factor, but if it was at all comparable to the armored suits worn by the Federal Empire's own assault squads during the Thousand Years War, it might be able to deflect laser fire, to withstand small explosions, to ignore sonic attacks. But a plasma cannon could melt through five meters of solid duralloy plate. One good plasma-ball would instantly turn any kind of personal armor into slag, and Nevis would be incinerated before he even understood what had hit him.

The difficulty was the size of the plasma cannon. It was unfortunately cumbersome, and the so-called portable version, with its small energy-pac, took almost a full standard minute after each shot to generate another plasma-ball in its force chamber. Jefri Lion was acutely and uncomfortably aware that, were he to miss Kaj Nevis, he would be unlikely to get a second shot. Moreover, even on its tripod, the plasma-cannon was unwieldy, and it had been many years since he had been in the field; and even then, his strong suits had been his mind and his tactical sense, not his reflexes. After so many decades at the ShanDellor Center, he had no great confidence in his hand-eye coordination.

So Jefri Lion concocted a plan.

Fortunately, plasma cannons had often been employed for automated perimeter defense, and this one had the standard minimind and autofire sequence. Jefri Lion erected the tripod in the middle of a broad corridor, approximately twenty meters down from a major intersection. He programmed in an extremely narrow field of fire, and calibrated the targeting cube with the utmost precision. Then he initiated the autofire sequence and stepped back with satisfaction. Inside the energy-pac he saw the plasma-ball forming, burning brighter and brighter, and after a minute the ready light flashed on. Now the cannon was set, and its minimind was vastly quicker and more deadly accurate than Lion could ever hope to be firing manually. It was targeted on the center of the corridor intersection ahead, but it would fire only at objects whose dimensions exceeded certain pre-programmed limits.

So Jefri Lion could dash right through the cannon's target cube without fear, but Kaj Nevis, following in his absurdly huge battlesuit, would meet with a hot surprise. Now it only remained to lure Nevis into the appropriate position.

It was a stroke of tactical genius worthy of Napoleon or Chin Wu or Stephan Cobalt Northstar. Jefri Lion was infinitely pleased with himself.

The heavy footsteps had grown louder as Lion had worked with the plasma cannon, but in the last minute or so they

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had begun to fade; Nevis had obviously taken a wrong turning and would not be coming to the right position of his own accord. Very well then, Jefri Lion thought; he would bring him there.

He walked to the precise center of the fire zone with complete confidence in his own abilities, paused there briefly, smiled, and set off down the cross-corridor to attract the attention of his unwary prey.

Up on the great curved telescreen, the *Ark* revolved in three-dimensional cross-section.

Rica Dawnstar, having abandoned the captain's throne for a less comfortable but more efficient post at one of the bridge work stations, studied the display, and the data flashing by underneath it, with some annoyance. It seemed she had a lot more company that she had thought.

The system displayed intruding life forms as vivid red pinpoints of light. There were six pinpoints. One of them was on the bridge. Since Rica was quite alone, obviously that was she. But five others? Even if Anittas was still alive, there should have been only two additional dots. It didn't add up.

Maybe the *Ark* hadn't been derelict after all. Maybe there was still someone aboard. Except the system claimed to depict authorized *Ark* personnel as green dots. There was no green to be seen.

Other scavengers? Highly unlikely.

It had to mean that Tuf, Lion, and Waan had somehow docked after all. That made the most sense. And, indeed, the system claimed there was an intruding life form in a ship up on the landing deck.

All right. That added up. Six red dots equaled her and Nevis and Anittas (how had he lived through the damned plagues? the system insisted it was showing only *living* organisms) plus Tuf and Waan and Lion. One of the others was still up in the *Cornucopia*, and the rest . . .

It was simple to pick out Kaj Nevis. The system showed power sources as well, as tiny yellow starbursts, and only one of the red pinpoints was surrounded by a tiny yellow starburst. That had to be Nevis in his battlesuit.

But what was that second yellow dot flashing so brightly by itself in an empty corridor on deck six? A hellacious power source, but what? Rica didn't understand. There had been a second red dot quite near to it, but it had moved away, and now seemed to be trailing Nevis, edging steadily closer.

Meanwhile, there were the black dots: the *Ark*'s bio-weapons. The huge central axis that cored the asymmetric, tapered cylinder of the ship was positively livid with black pinpricks, but at least those were stationary. Other black dots, which had to be the beasties that had gotten released, were moving through the corridors. Only there were more than five. There was one clump of them; thirty or more discreet organisms, moving en masse like a shapeless black blotch upon the screen, throwing off strays from time to time. One of the strays had come up near a red light and had suddenly been extinguished.

There was a red dot in that central core area, too.

Rica asked for a display of that sector, and the screen gave her a much tighter cross-section. The red light was very

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close to a moving black dot down there. Some sort of confrontation. She studied the readouts below the graphic. That particular black dot was species #67-001-00342-10078, the Tyrannosaurus Rex. It was massive, no doubt of that.

She noticed, with some interest, that a red light and one of the wandering blacks were both closing in on Kaj Nevis. That ought to be interesting. It looked like she was missing the party; all hell was breaking loose down there.

And she was up here, safe and secure and in control. Rica Dawnstar smiled.

Kaj Nevis was lumbering down a corridor, growing more and more angry, when a sudden explosive blow took him squarely in the back of his head. Inside his helmet, the sound was horrible. The force of the explosion knocked him forward and toppled him. He went smashing to the floor face first, too slow to break his fall with his arms.

But the suit absorbed most of the impact, and Nevis was unharmed. Lying there he made a quick check of his gauges, and smiled wolfishly; the battlesuit was undamaged, unbreached. He rolled over and rose ponderously to his feet.

Twenty meters away, at a corridor insection, stood a man in a green-and-gold pressure suit, armed as if he had just looted a military museum, and holding a pistol in one gloved hand. "We meet again, blackguard!" the figure called out over external speakers.

"SO WE DO, LION," Nevis replied. "HOW GOOD TO SEE YOU. COME HERE AND SHAKE HANDS." He snapped his pincers. The right one was still stained with the cybertech's blood; he hoped Jefri Lion had noticed. A pity his cutting laser was so short-range, but no matter. He would simply catch Lion and take away his toys and then play with him awhile. Pull off his legs, perhaps, and breach his suit, and let the damned air do the rest.

Kaj Nevis lumbered forward.

Jefri Lion stood his ground, raised his dart pistol and aimed it carefully with both hands, fired.

The dart struck Nevis in the chest. There was a loud explosion, but this time he had braced for it. His ears hurt, but he hardly even staggered. Some of the intricate filigree on the armor was blackened, and that was the extent of the damage. "YOU LOSE, OLD MAN," Nevis said. "I LIKE THIS SUIT."

Jefri Lion was silent and methodical. He holstered his dart pistol, unslung a laser rifle and raised it to his shoulder, took aim, fired.

The beam glanced off Nevis's shoulder, struck a wall, and burned a small black hole.

"Reflective microcoating," Jefri Lion said. He put away the laser rifle.

Nevis had eaten up more than three-quarters of the distance between them with his long powered strides. Finally Jefri Lion seemed to realize his danger. He threw down the laser rifle, turned, and darted around a corner, out of sight.

Kaj Nevis lengthened his strides and followed.

Haviland Tuf was nothing if not patient.

He sat calmly, with his hands folded atop his bulging stomach and his head aching from the repeated blows the ty-

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rannosaur had inflicted on the sheltering table. He did his best to ignore the hammering that dented the metal above and made him even more uncomfortable, the blood-curdling bestial roars, the excessive and melodramatic displays of carnivore appetite that occasionally prompted the tyrannosaur to bend over and snap its numerous large teeth futilely at Tuf in his shelter. Instead Tuf thought about sweet Rodelyian pop-berries in honey-butter, tried to recall which particular planet had the strongest and most pungent variety of ale, and devised an excellent new strategy with which to overwhelm Jefri Lion should they ever game again.

Ultimately his plan bore fruit.

The raging reptile, bored and frustrated, went away.

Haviland Tuf waited until it grew quite still and silent outside. He twisted himself around awkwardly, and lay for a moment on his stomach while the pins and needles in his legs flared and faded and vanished. Then he squirmed forward and cautiously stuck his head out.

Dim green light. Low humming, and distant gurgling sounds. No motion anywhere.

He emerged carefully.

The dinosaur had struck what remained of Mushroom's poor body numerous times with its massive tail. The sight filled Haviland Tuf with a vast and bitter sorrow. The equipment at this particular work station was in a shambles.

Yet there were other work stations.

And he needed but a single cell.

Haviland Tuf gathered up a tissue sample and walked ponderously down to the next work station. This time he made it a point to listen for the sound of dinosaur footsteps behind him.

Celise Waan was pleased. She had handled herself quite adroitly, no doubt of it. That nasty little cat-thing wouldn't be bothering her again. Her faceplate was a bit smeared where the cat-spit had struck, but otherwise she had come off splendidly from the encounter. She holstered her pistol deftly, and stalked back out into the corridor.

The smear on her faceplate bothered her a little. It was up near her eyes, and it obscured her vision. She wiped at it with the back of her hand, but that only seemed to spread the smeariness around. Water, that was what she needed. Very well then. She had been looking for food anyway, and where you found food you always found water.

She walked briskly down the corridor, turned a corner, and stopped dead.

Not a meter away, another of those damned cat-things stood staring at her insolently.

This time Celise Waan acted decisively. She went for her pistol. She had some trouble getting it out, however, and her first shot missed the disgusting creature entirely and blew the door off a nearby room. The explosion was loud and startling. The cat hissed, drew back, spit just like the first one had, and then ran.

Celise Waan caught the spittle up near her left shoulder this time. She tried to get off a second shot, but the smeary condition of her helmet's faceplate made it difficult to see where she was aiming.

"Stuff and nonsense," she said loudly in exasperation. It was getting harder and harder to see. The plastic in front

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of her eyes seemed to be getting cloudy. The edges of the faceplate were still clear, but when she looked straight ahead everything was vague and distorted. She really had to get the helmet cleaned off.

She moved in the direction she thought the cat-thing had taken, going slowly so as not to trip. She tried to listen. She heard a soft scrabbling sound, as if the creature was nearby, but she couldn't be sure.

The faceplate was getting worse and worse. It was like looking through milk-glass. Everything was white and cloudy. This wouldn't do, Celise Waan thought. This wouldn't do at all. How could she hunt down that hideous cat-creature if she was half-blind? For that matter, how could she find where she was going? There was no help for it; she would have to take off this stupid helmet.

But the thought gave her pause; she remembered Tuf and his dire warnings about sickness in the ship's air. Well, yes, but Tuf was such a ridiculous man! Had she seen any proof of what he said? No, none at all. She'd put out that big gray cat of his, and it certainly didn't seem to suffer any for the experience. Tuf had been carrying it around the last time she'd seen him. Of course, he had done that big song and dance about incubation periods, but he was probably just trying to frighten her. He seemed to enjoy outraging her sensibilities, the way he had with his revolting cat food trick. No doubt he would find it perversely amusing if he frightened her into remaining in this tight, uncomfortable, smelly suit for weeks.

It occured to her suddenly that Tuf was probably responsible for these cat-things that were harassing her. The very idea made Celise Waan furious. The man was a barbarous wretch!

She could hardly see a thing now. The milky center of her faceplate had grown almost opaque.

Resolute and angry, Celise Waan unsealed her helmet, took it off, and threw it down the corridor as far as she could.

She took a deep breath. The ship's air was slightly cold, with a faint astringency to it, but it was less musty than the recycled air from the suit's air-pac. Why, it tasted good! She smiled. Nothing wrong with this air. She looked forward to finding Tuf and giving him a tongue-lashing.

Then she happened to glance down. She gasped.

Her glove . . . the back of her left hand, the hand she'd used to wipe away the cat-spit, why, a big hole had appeared in the center of the gold fabric, and even the metal weave beneath looked, well, *corroded*.

That cat! That damned cat! Why, if that spit had actually struck her bare skin, it would have . . . it could have . . . she remembered all of a sudden that she was no longer wearing a helmet.

Down the corridor, the cat-thing suddenly popped out of an open room.

Celise Waan shrieked at it, whipped up her pistol, and fired three times in rapid succession. But it was too fast. It ran away and vanished down around a corner.

She wouldn't feel safe until the pestilential thing was disposed of for good and all, she decided. If she let it get away, it might pounce on her at any unguarded moment, the way Tuf's ob-

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noxious black-and-white pet was so wont to do. Celise Waan opened her pistol, fed in a fresh clip of explosive darts, and moved off warily in pursuit.

Jefri Lion's heart was pounding as it had not pounded in years; his legs ached and his breath was coming in hard, short little gasps. Adrenalin surged through his system. He pushed himself harder and harder. Just a little farther now, down this corridor and around the corner and then maybe twenty meters on to the next intersection.

The deck underfoot shook every time Kaj Nevis landed on one of his heavy, armored, saucer-feet, and once or twice Jefri Lion almost lost his footing, but the danger only seemed to add spice. He was running like he'd run as a youth, and even Nevis's huge augmented strides were not enough to catch him, though he could feel the other closing on him.

He had pulled out a light-grenade as he ran. When he heard one of Nevis's damnable pincers snap within a meter of the back of his head, Jefri Lion armed it and flipped it over his shoulder and pushed himself even harder, darting around the last corner.

He whirled as he made the turn, just in time to see a sudden soundless flash of blue-white brilliance blossom in the corridor he had evacuated. Even the reflected light that blazed off the walls left Jefri Lion momentarily dazzled. He backpedalled, watching the intersection. Seen directly, the light-grenade ought to have burned out Nevis's retinas, and the radiation ought to be enough to kill him within seconds.

The only sign of Nevis was a huge, utterly black shadow that loomed across the intersection.

Jefri Lion retreated, running backward now, panting.

Kaj Nevis stepped out slowly into the intersection. His faceplate was so dark it looked almost black, but as Lion watched the red glow returned, burning brighter and brighter. "DAMN YOU AND ALL YOUR STUPID TOYS," Nevis boomed.

Well, it didn't matter, thought Jefri Lion. The plasma cannon would do the job, there was no doubt of that, and he was only ten meters or so from the fire zone. "Are you giving up, Nevis?" he taunted, trotting backward easily. "Is the old soldier too fast for you?"

But Kaj Nevis didn't move.

For a moment, Jefri Lion was baffled. Had the radiation gotten to him after all, even through the suit? No, that couldn't be it. Surely Nevis wouldn't give up the chase now, not after Lion had lured him so heartbreakingly close to the fire zone and his plasma-ball surprise.

Nevis laughed.

He was looking up over Lion's head.

Jefri Lion looked up too, just in time to see something detach itself from the ceiling and come flapping down at him. It was all a sooty black, and it rode on wide dark batwings, and he had a brief vision of slitted yellow eyes with thin red pupils. Then the darkness folded over him like a cape, and leathery, wet flesh closed about him to muffle his sudden, startled scream.

It was all very interesting, Rica Dawnstar thought.

Once you mastered the system, once you got the commands down, you could

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find out all sorts of things. Like, for example, the approximate mass and body configuration of each of those little lights moving up on the screen. The computer would even work up a three-dimensional simulation for you, if you asked it nicely. Rica asked it nicely.

Now everything was falling into place.

Anittas was gone after all. The sixth intruder, back on the *Cornucopia*, was only one of Tuf's cats.

Kaj Nevis and his supersuit were chasing Jefri Lion around the ship. Except one of the black dots, the hooded dracula, had just gotten ahold of Lion.

The red dot that was Celise Waan had stopped moving, although it hadn't winked out. The creeping black mass was coming toward her.

Haviland Tuf was alone in the central axis, putting something in a cloning vat and trying to ask the system to activate the stasis field. Rica let the command go through.

All of the other bio-weapons were out in the corridors.

Rica decided to let things sort themselves out a little more down there before she took a hand.

Meanwhile, she'd rummaged up the program to cleanse the interior of the ship of plague. First she'd have to close all the emergency locks, seal off each sector individually. Then the process could begin. Atmosphere evacuation, filtration, irradiation, with massive redundency built in for safety, and when the replacement atmosphere flowed back it was infused with all the proper antigens. Complex and time-consuming. But effective.

And Rica was in no special hurry.

* * *

Her legs had collapsed first.

Celise Waan lay in the center of the corridor where she had fallen, her throat constricted with terror. It had all happened so suddenly. One moment she was rushing headlong down the hall in pursuit of the cat-thing. And then a wave of dizziness had swept over her, and suddenly she felt too weak to go on. She had decided to rest for a moment, had squatted down to catch her breath. But it didn't help. She only felt worse and worse, and when she tried to get up, her legs had buckled under her and she'd pitched forward onto her face.

After that her legs refused to move. Now she couldn't even feel them. She couldn't feel anything below her waist, in fact, and the paralysis was creeping up her body slowly. She could still move her arms, but it hurt when she did, and her motions were leaden and clumsy.

Her cheek was pressed against the hardness of the deck. She tried to raise her head, and failed. Her whole upper body shook to a sudden stabbing pain.

Two meters away, a cat-thing peered out from around a corner. It stood staring at her, its eyes huge and scary. Its mouth opened in a hiss.

Celise Waan tried to stifle a scream.

Her pistol was still in her hand. Slowly, jerkily, she dragged it forward to her face. Every motion was agony. She lined it up at best she could, squinting along the top of it, and fired.

The dart actually hit.

She was showered with pieces of cat-thing. One piece, raw and wet and disgusting, landed on her bare cheek.

It made her feel a little better. At least

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she'd killed the creature that had tormented her. At least she was safe from that. She was still sick and helpless, though. Maybe she should rest. A little nap, yes, she'd feel better after a little nap.

Another cat-thing bounded out into the corridor.

Celise Waan groaned, tried to move, gave up the effort. Her arms were growing heavier and heavier.

A second cat followed the first. Celise pushed her dart-gun to her cheek again, tried to aim. She was distracted when a third cat appeared. The dart went wide, exploded harmlessly way off down the corridor.

One of the cats spit at her. It struck her between the eyes.

The agony was unbelievable. If she could have moved, she would have torn her eyes from their sockets, rolled on the ground, pulled at her skin. But she couldn't move. She screamed.

Her vision distorted into a hideous blur of color and then was gone.

She heard . . . feet. Small, light, padding footsteps. Cat steps.

How many were there?

Celise felt a weight on her back. And then another, and another. Something nudged against her useless right leg; she could dimly sense it shifting.

There was a spitting sound, and agony flared on her cheek.

They were all around her, on top of her, crawling over her. She could feel the stiffness of their fur brushing against her hand. Something bit into the flesh of her neck. She screamed. The biting continued. It took hold, pulling, worrying at her with small sharp teeth.

Another one nipped at a finger. Somehow the pain gave her strength. She flailed at it, pulled back her hand. When she moved, there was a cacophony of hissing all around her as the cat-things protested. She felt them biting her face, her throat, her eyes. Something was trying to squirm down into her suit.

Her hand moved slowly, awkwardly. She brushed aside cat-things, was bitten, persisted. She fumbled at her belt, and at last she felt it, round and hard within her grip. She pulled it loose, brought it up toward her face, held it oh so tight.

Where was the stud that armed it? Her thumb searched. *There*. She twisted it a half-turn, pressed it in as Lion had told her to.

Five, she recited silenty, four three two one.

In her last moment. Celise Waan saw the light.

Kaj Nevis had himself a good loud laugh as he watched the show.

He didn't know what the hell the damned thing was, but it was more than enough for Jefri Lion. Its wings folded over him when it hit, and for a few minutes he screamed and struggled, rolling around on the floor with the thing enveloping his head and shoulders. He looked like a man fighting an umbrella. It was downright comic.

After a while, Lion lay still, his legs kicking feebly. The screaming stopped. A sucking sound filled the corridor.

Nevis was amused and pleased, but he figured it was best not to leave any loose ends. The thing was intent on its feeding. Nevis walked up as quietly as he could manage, which wasn't very

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quietly, and grabbed it. It made a liquid popping sound when he pulled it off what was left of Jefri Lion.

Damn, Nevis thought, it did one hell of a job. The whole front of Lion's helmet was staved in; the thing had a kind of boney sucker-beak, and it had punched right through Lion's faceplate and sucked off most of his face. Ugly. The flesh looked almost liquified, and there was bone showing through.

The monster was flapping madly in his grip, and making a high, hideous noise, half shriek and half whine. Kaj Nevis held it at arm's length and let it flap while he studied it. It struck at his arm, again and again, to no effect. He liked those eyes; real mean, scary eyes. This thing could be handy, he thought. He pictured what it would be like to dump a couple hundred of these down into Shandicity some night. Oh, they'd meet his price. They'd give him any damn thing he asked for, money, women, power, the whole damn world if that was what he wanted. It was going to be fun owning this ship.

In the meantime, though, this particular creature might be a nuisance.

Kaj Nevis took hold of a wing with each hand, and ripped it in half. Then, smiling, he went back the way he had come.

Haviland Tuf checked the instrumentation again, adjusted the fluid flow slightly. Satisfied, he folded his hands atop his stomach and took up his position by the vat. Within, opaque red-black liquid swirled and churned. Tuf felt a certain sense of vertigo watching it; that was a side-effect of the stasis field, he knew. In that tiny tank, so small he could almost encompass it with his two large hands, vast primal energies were at play, and time itself was hurrying at his command. It filled him with a singular sense of awe and reverence.

The nutrient bath was thinning gradually, becoming almost translucent. Within, Tuf fancied that he could almost see a dark shape taking form, growing, growing visibly, ontogeny taking place before his eyes. Four paws, yes, he could see them. And a tail. That was most definitely a tail, Tuf decided.

He moved back to the instrumentation. It would not do for his creation to be vulnerable to the contagions that had killed Mushroom. He recalled the innoculation the tyrannosaur had received shortly prior to its unexpected and inconvenient release. No doubt there was a way to administer the appropriate antigens and prophylactics before completing the birth process. Haviland Tuf commenced to do just that.

The *Ark* was almost clean. Rica had sealed the barriers throughout three-quarters of the ship, and the sterilization program was proceeding with its own inexorable, automated logic. The landing deck, engineering, drive room, control tower, bridge, and nine other sectors showed a clean pale blue now on the telescreen status display. Only the great central axis and the main corridors and laboratory areas in close proximity to it were still shaded with that corrosive reddish hue that signified an atmosphere laced through with disease and death in all those myriad forms.

That was the way Rica Dawnstar wanted it. In those interconnected central sectors, another kind of process was

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working itself out with similar remorseless logic. And the final equation, she had no doubt, would leave her in sole and complete control of the seedship and all its knowledge, power, and wealth.

Now that her environment was clean and safe, Rica had gratefully removed her helmet. She had ordered up some food as well; a thick white slab of protein from some creature called a meatbeast that *Ark* had held in a succulent stasis for a millenium, washed down with a tall chilled glass of sweetwater that tasted slightly of Milidian honey. She enjoyed the snack as she watched the reports flow by.

Things had simplified themselves considerably down there. Jefri Lion was gone. A pity, in a way; he'd been harmless enough, although unbelievably naive. Celise Waan was out of it too, and, surprisingly, she'd managed to take the hellkittens out with her. Kaj Nevis had disposed of the hooded dracula.

Nobody left but Nevis and Tuf . . . and her.

Rica grinned.

Tuf was no problem. He was busy making a cat. He could be taken care of easily, one way or the other. No, the only real obstacle now standing between Rica and the prize was Kaj Nevis and the Unquin battlesuit. Kaj was probably feeling real confident by this point. Good. Let him.

Rica Dawnstar finished her meal, and licked the ends of her fingers. It was time for her zoology lesson, she figured. She called up reports on the three bioweapons still out roaming the ship. If none of them would do, what the hey, she still had thirty-nine more in stasis just waiting for release. She could pick and choose her executioner.

A battlesuit? What she had was better than a hundred battlesuits.

When she had finished reading the zoological profiles, Rica Dawnstar was smiling broadly.

Forget the reserves. The only problem was making the right introductions. She checked out the geography up on the telescreen, and tried to consider just how devious a mind old Kaj Nevis had.

Not nearly devious enough, Rica suspected.

The damned corridors went on and on and never seemed to lead anywhere but to other corridors. His gauges showed that he had already begun drawing air from his third tank. Kaj Nevis knew he had to find the others quick, get them out of the way so he could settle down to the problem of figuring out how this damned ship worked.

He was striding down one especially long, wide corridor when suddenly a kind of plastic stripe inset into the deck lit up under his feet.

Nevis paused, frowning.

The trace gleamed suggestively. It led straight ahead, and turned to the right at the next inersection.

Nevis took a single step. The section of the trace behind him winked out.

He was being pointed somewhere. Anittas had muttered something about leading people around the ship just before he'd had his little haircut. This was how he did it, then. Could the cybertech still be alive somehow, haunting the *Ark*'s computer? Nevis doubted it. Anittas had seemed pretty damned dead to him, and he had a lot of experience with

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making people dead. Who was this then? Dawnstar, of course. Had to be. The cybertech said he'd led her to the control room.

So where was she trying to lead him?

Kaj Nevis thought about it for an instant. In his suit, he felt nigh-on invulnerable. But why take chances? Besides, Dawnstar was a treacherous little bitch. She might very well just lead him round and round forever, until his air ran out.

He turned resolutely and stalked off, moving in the opposite direction from the seductive silver guideline.

At the next turning, a green trace blazed to life, pointing to his left.

Kaj Nevis turned right.

The passage dead-ended in twin spiral escalators. When Nevis paused, one of them began to corkscrew up. He grimaced and walked down the unmoving one.

He descended three decks. At the bottom, the passageway was narrow and dark, and led off in two directions. Before Nevis could make a choice, there was a metallic scraping sound, and a sliding panel came out of a wall and closed off the right-hand corridor.

The bitch was still at it, he thought furiously. He looked down to the left. The corridor seemed to widen somewhat as it went, but it also got darker, and here and there it was broken by the hulks of old machinery. Nevis didn't like the looks of it.

If Dawnstar thought she could herd him along into a trap by closing a few doors, she had another thought coming. Nevis turned back to the sealed right-hand passage, drew back his foot, and kicked. The noise was deafening. He kicked again, and again, and then began to use his armored fists. He brought all the augmented exoskeletal strength of the battlesuit to bear.

Grinning, he stepped over what remained of the sliding panel into the dim, narrow passage that Dawnstar had tried to forbid to him. Underneath his feet was bare metal; the walls almost brushed his shoulders. It was an accessway of some sort, Nevis figured, but maybe it led to someplace important. Hell, it had to lead to someplace important. Why else had Dawnstar tried to keep him out of it?

His saucer-feet rang on the floorplates. He walked. It grew darker, but Kaj Nevis was determined. At one point, the passage made a sharp right hand bend, almost too narrow for him to get through in the battlesuit. He had to squeeze past that point with his arms retracted and his legs half-bent.

Around the turn, a small square of light appeared up ahead. Nevis moved toward it. Then, abruptly, he stopped. What was that?

There was a black blob of some sort, floating in the air ahead of him.

Kaj Nevis advanced cautiously.

The dark blob was small and round, barely the size of a man's fist. Nevis kept about a meter's distance from it, and studied it. Another creature. As damned ugly as the one that had dined on Jefri Lion, too, but weirder. It was brown and lumpy, and its hide looked like it was made of rocks. It looked almost like it *was* a rock, in fact; Nevis only knew it was alive because it had a mouth, a wet black hole in the rocky skin. Inside it was all moist and green and moving, and he could make out teeth, or what looked like teeth, except

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they looked metallic. He thought he saw a triple set of them, half-concealed by rubbery green flesh that pulsed slowly, steadily.

But the weirdest thing was how incredibly still it was. At first, Nevis thought it was hovering in the air somehow. But then he came a little closer and saw that he'd been wrong. It was suspended in the center of an incredibly fine web, the strands so very thin they were all but invisible. In fact, the ends of them *were* invisible. Nevis could make out the thickest parts near the nexus where the creature sat pulsing, but the webbing seemed to get thinner and thinner as it spread, and you couldn't see where it attached to wall or floor or ceiling at all, no matter how hard you looked.

A spider, then. A weird one. The rocky appearance made him think it was some kind of silicon-based life. He'd heard of that, here and there. It was real goddamned rare. So he had some kind of silicon-spider here. Big deal.

Kaj Nevis moved closer. Damn, he thought. The web, or what he thought was the web . . . hell, the damned thing wasn't sitting on the web, it was *part* of the web. Those fine, thin, shiny web strands grew out of its body, he saw. He could barely make out the joinings. And there were more than he thought, *hundreds* of them, maybe thousands, most of them too thin to be seen from any kind of distance at all, but when you looked at them from the right angle, you could seen the light gleaming off them, all silvery-faint.

Nevis edged back a step, uneasy despite the security of his armored suit, for no good reason that he could name. Behind the silicon-spider, light shone from the end of the accessway. There had to be something important there; that had to be why Rica Dawnstar had tried so hard to keep him away.

That was it, he thought to himself with grim satisfaction. That was probably the damned *control room* back there, and Rica was inside cowering, and this stupid spider was her last line of defense. It gave him the creeps, but what the hell else could it do to him?

Kaj Nevis shifted to his pincer arms and brought up the right pincer to snip the web.

The gleaming, bloodstained, serrated metal blades closed on the nearest visible strand, smoothly and easily. Gleaming, bloodstained, serrated shards of Unquish metal clattered down onto the floor plates.

The whole web began to vibrate.

Kaj Nevis stared at his lower right arm. Half of the pincer had been sheared off. Bile rose in his throat. He took a step backward, another, a third, putting distance between him and the, the, the *thing* back there.

A thousand web strands, thinner than threads, became a thousand legs. They left a thousand holes in the metal walls when they moved, and they scored the floor with their lightest touch.

Nevis ran. He stayed ahead until he came to the narrow place where the passage turned.

He was still lowering the suit's massive arms and attempting to wedge himself through when the walking-web caught him. It bobbed as it moved toward him, suspended on countless invisible legs, its mouth pulsing. Nevis made terrified choking sounds. A thou-

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sand monomolecular silicon arms enveloped him.

Nevis brought up a huge powered hand to grab the head of the thing, to crush it to a pulp. But the arms were everywhere, waving, closing about him languidly. He pushed against them, and they cut through metal, flesh, bone. Blood came spurting from the stump of his wrist. He screamed, briefly.

Then the walking-web tightened its embrace.

A hairline crack appeared in the plastic of the empty vat. The kitten batted at it. The crack widened. Haviland Tuf reached in and caught up the kitten in one large hand, brought it close to his face. It was tiny, and a bit feeble yet: perhaps he had initiated birth too soon. He would be more careful on his next attempt, but this time the insecurity of his position and the need for constant vigilance lest wandering tyrannosaurs interrupt his work, had resulted in a certain unseemly haste.

Nonetheless, he judged the trial a success. The kitten mewed. Haviland Tuf determined that it would be necessary to hand feed it milk from a dropper, yet he had no doubt that he was equal to the task. The kitten's eyes were barely open, and its long gray fur was still wet from the fluids in which it had been so recently immersed. Had Mushroom ever truly been this small?

"I cannot name you Mushroom," he told his new companion solemnly. "Genetically you are one, it is true, yet Mushroom was Mushroom and you are you and I would not have you confused. I shall name you Chaos, a fitting companion to Havoc." The kitten moved in his palm and opened and closed one eye, as if it understood; but then, as Tuf knew, all cats have a touch of psi.

He looked about him. Nothing more remained to be done here. Perhaps it was time to search out his erstwhile and unworthy companions, and attempt to arrive at some sort of mutually beneficial accomodation. Cradling Chaos in his arm, he set off in search of them.

It was all over but the shouting, Rica Dawnstar decided when Nevis's red light vanished from the screen. Now it was down to her and Tuf, which meant that for all practical purposes, she was mistress of the *Ark*.

What the hell would she do with it, she wondered? Hard to say. Sell it to some arms consortium or the highest-bidding world? Doubtful. She didn't trust anyone with quite that much power. Power corrupts, after all. Maybe she should keep it, run it. She was corrupt enough already, she ought to be immune. But it would get awfully lonely living in this morgue alone. She could hire crew, of course. Bring aboard friends, lovers, flunkies. Only how could she trust them? Rica frowned. Well, it was a knotty problem, but she had a long, long time to get a handle on it. She'd think about it later.

Right now, she had a more immediate problem to consider. Tuf had just left the central cloning chamber and was wandering out into the corridors. What was she going to do about him?

She studied the display. The walking-web was still in its lair, snug and warm, probably still feeding. The rolleram, all four metric tons of it, was down in the main corridor of deck six, rolling back

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and forth like some kind of berserk living cannonball of enormous size, caroming off of walls and searching in vain for something organic to roll over, crush, and digest.

The tyrannosaur was on the right level. What was it up too? Rica punched for more detail, and smiled. If her readouts could be believed, it was eating. Eating *what?* For a moment she drew a blank. Then it dawned on her. It had to be gulping down what remained of old Jeffri Lion and the hooded dracula. The location seemed about right.

All things considered, it was pretty close to Tuf. Unfortunately, when it began to move again, it headed off in the wrong direction. Maybe she should arrange a meeting.

She couldn't underestimate Tuf, though. He had already escaped the reptile once; he might be able to do it again. And even if she maneuvered him onto the same level as the rolleram, the same problem presented itself. Tuf had a certain native cunning. She'd never be able to lead old Tuffy by the nose the way she had with Nevis. He was too subtle. She recalled the games they'd played aboard the *Cornucopia*. Tuf had won all of them.

Release a few more bio-weapons? Easily done.

Rica Dawnstar hesitated. Ah, hell, she thought, there was an easier way. It was time she took a hand directly.

Hooked over one arm of the captain's throne was a thin coronet of iridescent metal that Rica had earlier removed from a storage cabinet. She picked it up, ran it under a scanner briefly to check the circuitry, and slid it over her head at a rakish angle. Then she donned her helmet, sealed up her suit, and took out her needler. Once more into the breach.

Wandering about in the corridors of the *Ark*, Haviland Tuf found a vehicle of sorts, a small, open, three-wheeled cart. He had been standing for some time, and before that had been hiding underneath a table. He was only too glad to be seated. He drove along at a smooth, steady, comfortable speed, sitting back against the cushion and looking straight ahead. Chaos rode in his lap.

Tuf drove through several kilometers of corridor. He was a cautious and methodical driver. At every intersection he stopped, looked right, looked left, and weighed his choices before proceeding. He turned twice, as dictated partly by stern logic and partly by sheerest whim, but stayed for the most part to the widest corridors. Once he stopped and dismounted to explore a set of doors that seemed interesting. He saw nothing, encountered no one. Now and again, Chaos moved about in his lap.

Then Rica Dawnstar appeared up ahead of him.

Haviland Tuf stopped his cart in the center of a great intersection. He looked right, and blinked several times. He looked left. Then he stared straight ahead, hands folded on top of his stomach, and watched as she came toward him slowly.

She stopped about five meters away, down the corridor. "Out for a drive?" she asked. In her right hand she carried her familiar needler. In her left hand was a tangle of straps that trailed down onto the deck.

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"Indeed," said Haviland Tuf. "I have been occupied for some time. Where are the others?"

"Dead," Rica Dawnstar said. "Deceased. Gone. Eliminated from the game. We're the end of it, Tuf."

"A familiar situation," Tuf said flatly.

"This is the last game, Tuf," Rica Dawnstar said. "No rematch. And this time I win."

Tuf stroked Chaos and said nothing.

"Tuf," she said amiably, "you're the innocent in all this. I've got nothing against you. Take your ship and go."

"If you refer to the *Cornucopia of Excellent Goods at Low Prices*," said Haviland Tuf, "might I remind you that it suffered grave damage which has not yet been repaired?"

"Take some other ship, then."

"I think not," Tuf said. "My claim to the *Ark* is perhaps inferior to that of Celise Waan, Jefri Lion, Kaj Nevis, and Anittas, yet you tell me that all of them are deceased, and my claim is surely as good as your own."

"Not quite," said Rica Dawnstar. She raised her needler. "This gives my claim the edge."

Haviland Tuf looked down at the kitten in his lap. "Let this be your first lesson in the hard ways of the universe," he said loudly. "What matters fairness, when one party has a gun and one does not? Brute violence rules everywhere, and intelligence and good intent are trampled upon." He stared back at Rica Dawnstar. "Madam," he said, "I acknowledge your advantage. Yet I must protest. The deceased members of our group admitted me to a full share in this venture before we came aboard the *Ark*. To my knowledge, you were never similarly included. Therefore I enjoy a legal advantage over you." He raised a single finger. "Furthermore, I would advance the proposition that ownership is conferred by use, and the ability to use. The *Ark* should, optimally, be under the command of the person who has demonstrated the talent, intellect, and will to make the most effective use of its myriad capabilities. I submit that I am that person."

Rica Dawnstar laughed. "Oh, really?"

"Indeed," said Haviland Tuf. He cupped Chaos in his hand, and lifted the kitten for Rica Dawnstar to see. "Behold my proof. I have explored this ship, and mastered the cloning secrets of the vanished Earth Imperials. It was an awesome and intoxicating experience, and one I am anxious to replicate. In fact, I have decided to give up the crass calling of the merchant, for the nobler profession of ecological engineer. I would hope you would not attempt to stand in my way. Rest assured, I will furnish you with transport back to ShanDellor and see to it personally that you receive every fraction of the fee promised to you by Jefri Lion and the others."

Rica Dawnstar shook her head in disbelief. "You're priceless, Tuffy," she said. She stepped forward, spinning her needler around her finger. "So you think you ought to get the ship because you can use it, and I can't?"

"You have outlined the very heart of it," Tuf said approvingly.

Rica laughed again. "Here, I don't need this," she said lightly. She tossed her needler at him.

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Tuf reached up and snatched it out of the air. "It would seem that my claim has been unexpectedly and decisively strengthened. Now I may threaten to shoot you."

"But you won't," Rica said. "Rules, Tuf. You play the game by the rules. I'm the kid that likes to kick over the board." She slung the tangled straps she had been dragging over her shoulder. "You know what I've been up to while you've been cloning yourself a kitten?"

"Obviously I do not," said Haviland Tuf.

"Obviously," Rica echoed sardonically. "I've been up on the bridge, Tuf, playing the computer and learning just about everything I need to know about the EEC and its *Ark*."

Tuf blinked. "Indeed."

"There's a swell telescreen up there," she said. "Think of it like a big gaming board, Tuf. I've been watching every move. The red pieces, they were you and the rest of them. Me too. And the black pieces. The bio-weapons, as the system likes to call 'em. I like the sound of *monsters* better myself. Shorter. Less formal."

"Fraught with strong connotations, however," Tuf put in.

"Oh, certainly. But to the point. We got through the defense sphere, we even handled the plague defense, but Anittas got himself killed and decided to get a little revenge, so he kicked loose the monster defense. And I sat up on top and watched the red and the black chase each other. But something was missing, Tuf. Know what?"

"I suspect this to be a rhetorical question," Tuf said.

"Indeed," mocked Rica Dawnstar, with laughter. "The *greens* were missing, Tuf! The system was programmed to show intruders in red, its own bio-weapons in black, and authorized *Ark* personnel in green. There were no greens, of course. Only that got me thinking, Tuf. The monster defense was obviously a last resort fallback position, sure. But was it intended for use *only* when the ship was derelict, abandoned?"

Tuf folded his hands. "I think not. The existence of the telescreen display capacity implies someone to watch said display. Moreover, if the system was coded to display ship's personnel, intruders, and monstrous defenders simultaneously and in variant colors, then the possibility of all three groupings being aboard and active at the same time must have been considered."

"Yes," said Rica Dawnstar. "Now, the key question."

In the corridor behind her, Haviland Tuf glimpsed motion. "Excuse me," he began.

Rica waved him quiet. "If they were prepared to turn loose these caged horrors of theirs to repel boarders in an emergency, *how did they prevent their own people from getting killed?*"

"An interesting quandry," Tuf admitted. "I eagerly anticipate learning the answer to this puzzle. I fear I will have to defer that pleasure, however." He cleared his throat. "Far be it from me to interrupt such a fascinating discourse. I feel obliged to point out, however . . ." The deck shook.

"Yes," Rica said, grinning.

"I feel obliged to point out," Tuf repeated, "that a rather large carnivorous dinosaur has appeared in the cor-

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ridor behind you, and is presently attempting to sneak up on us. He is not doing a very good job of it."

The tyrannosaur roared.

Rica Dawnstar was undisturbed. "Really?" she said laughing. "Surely you don't expect me to fall for the old there's-a-dinosaur-behind-you gambit. I expected better of you, Tuf."

"I protest! I am completely sincere." Tuf turned on the motor of his cart. "Witness the speed with which I have activated my vehicle, in order to flee the creature's approach. How can you doubt me, Rica Dawnstar? Surely you hear the beast's thunderous approach, the sound of its roaring?"

"What roaring is that?" Rica asked. "No, seriously, Tuf, I was telling you something. The answer. We forgot one little piece of the puzzle."

"Indeed," said Tuf. The tyrannosaur was moving toward them at an alarming velocity. It was in a foul temper, and its roaring made it difficult to hear Rica Dawnstar.

"The Ecological Engineering Corps were more than cloners, Tuf. They were military scientists. They were *genetic engineers* of the first order. They could recreate the life forms of hundreds of worlds and bring them alive in their vats, but that was not *all* they could do. They could also tinker with the DNA itself, *change* those life forms, redesign them to suit their own purposes!"

"Of course," Tuf said, "pardon me, but now I fear I must run away from the dinosaur." The tyrannosaur was ten meters behind Rica. It paused; its lashing tail struck the wall, and Tuf's cart shook to the impact. Slaver was drip-

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ping from its fangs, and its stunted forelegs clawed the air with unseemly eagerness.

"That would be very rude," Rica said. "You see, Tuf, that's the answer. These bio-weapons, these monsters—they were held in stasis for a thousand years, likely for longer than that. But they weren't ordinary monsters. They were cloned for a special purpose, to defend the ship against intruders, and they had been genetically manipulated to just that end." The tyrannosaur took one step, two, three, and now it was directly behind her, its shadow casting her in darkness.

"How manipulated?" asked Haviland Tuf.

"I thought you'd never ask," said Rica Dawnstar. The tyrannosaur leaned forward, roared, opened its massive jaws, engulfed her head. "Psionics," she said from between its teeth.

"Indeed," said Haviland Tuf.

"A simple psionic capacity," Rica announced from inside the tyrannosaur's jaws. She reached up and picked something from between its teeth, with a *tsk*ing sound. "Some of the monsters were close to mindless, all instinct. They got a basic instinctual aversion. The more complex monsters were made psionically submissive. The instruments of control were psi-boosters. Pretty little things, like crowns. I'm wearing one now. It doesn't confer psi powers or anything dramatic like that. It just makes some of the monsters avoid me, and other ones obey me." She ducked out of the dinosaur's mouth, and slapped the side of his jaw soundly. "Down, boy," she said.

The tyrannosaur roared, and lowered its head. Rica Dawnstar untangled her harness and saddle and began to strap it into place. "I've been controlling him *all* the time we've been talking," she said conversationally. "I called him here. He's *hungry*. He ate Lion, but Lion was small, and dead too, and he hasn't had anything else for a thousand years."

Haviland Tuf looked at the needler in his hand. It seemed worse than useless. He was a poor shot in any case. "I would be most glad to clone him a stegosaurus."

"No thanks," Rica said as she tightened the harness, "you can't get out of the game now. You wanted to play, Tuffy, and I'm afraid you lose all around. You should have gone away when I offered you the chance. Let's review your claim, shall we? Lion and Nevis and the others offered you a full share, yes, but of what? I'm afraid now you get a full share, whether you want one or not. A share of everything they got. So much for your legal argument. As for your moral claim on the basis of superior utility," she slapped the dinosaur again, and grinned, "I think I've demonstrated that I can put the *Ark* to more effective use than you can. Down a little more." The beast leaned over still further, and Rica Dawnstar vaulted into the saddle on its neck. "Up!" she barked. It stood.

"Therefore we put legality and morality aside, and again return to violence," Tuf said.

"I'm afraid so," Rica said from on top of her tyrant lizard. It came forward slowly, as if she were feeling her way. "Don't say I didn't play fair, Tuf. I've got the dinosaur, but you've got my

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needler. Maybe you'll get a lucky hit. So we're both armed." She laughed. "Only I'm armed to the teeth."

Haviland Tuf stood and tossed back her needler, overhand. It was a good throw. Rica leaned out to one side, caught it. "What's this?" she said. "Giving up?"

"Your scruples about fairness have impressed me," said Tuf. "I would take no advantage. You have a claim, I have a claim. You have an animal." He stroked his kitten. "I have an animal too. Now you have a gun." He activated his cart and backed away from the intersection, rolling quickly down the corridor behind him, or at least as quickly as he could go in reverse.

"Have it your way," Rica Dawnstar said. She was done playing. She felt a little sad. Tuf was turning his cart about to flee headlong instead of backward. The tyrannosaur opened its mouth wide, and slaver ran from half-meter long teeth. It screamed a scream that was pure red primal hunger a million years old, and came roaring down on him.

It roared down the corridor and into the intersection.

Twenty meters away along the cross-corridor, the minimind of the plasma-cannon took cognizance of the fact that something exceeding the programmed target dimensions had entered the fire zone. There was the faintest of clicks.

Haviland Tuf was turned away from the glare; he put his body between Chaos and the heat and awful noise. It lasted only an instant, fortunately, although the smell of burnt reptile would linger in that spot for years, and sections of the deck and walls would need to be replaced.

"I had a gun too," said Haviland Tuf to his kitten.

Later, much later, when the *Ark* was clean and he and Havoc and Chaos were settled comfortably into the captain's suite, and he had moved all his personal effects and taken care of all the bodies and done what repairs he could and figured out how to placate the incredibly noisy creature that lived down on deck six, Haviland Tuf began to search the ship methodically. On the second day, he found a store of clothing, but the men and women of the EEC had been shorter than he, and more slender, so none of the uniforms fit.

He did, however, find a hat he took rather a liking to. It was a green duck-billed cap, and it fit snugly atop his bald, milk-white head. On the front of it, in gold, was the theta that had been the sigil of the corps.

"Haviland Tuf," he said to himself in the mirror, "ecological engineer."

It had a certain ring to it, he thought. ■

● *Cynic,* n. A blackguard whose faulty vision sees things as they are, not as they ought to be. Hence the custom among the Scythians of plucking out a cynic's eyes to improve his vision.

Ambrose Bierce *(The Devil's Dictionary)*

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the reference library

By Tom Easton

Emergence, David R. Palmer, Bantam, $2.95, 304 pp.
Palimpsests, Carter Scholz and Glenn Harcourt, Ace, $2.95, 272 pp.
The Infinity Link, Jeffrey A. Carver, Bluejay, $16.95, 544 pp.
The Eye of the Heron, Ursula K. Le Guin, Bantam, $2.95, 181 pp.
Homecoming, John Dalmas, TOR, $2.95, 247 pp.
Valentina, Joseph H. Delaney and Marc Stiegler, Baen Books, $3.50, 320 pp.
Demon in the Skull, Frederik Pohl, DAW, $2.50, 158 pp.
The Man of Gold, M. A. R. Barker, DAW, $3.50, 367 pp.
The Alien Trace, H. M. Major, Signet, $2.95, 223 pp.
The Dark Tide, Dennis L. McKiernan, Doubleday, $11.95, 173 pp.
Spirits of Flux and Anchor, Book One: Soul Rider, Jack L. Chalker, TOR, $2.95, 320 pp.
The Clarion Awards, Damon Knight, ed., Doubleday, $11.95, 178 pp.

Titles are curious things. They range from one word to half a dozen, rarely more. The word or words can be virtually any in the English language (as far as we are concerned), of which there are, let's say, 150,000. That means there are 150,000 possible one-word titles and 1.14×10^{31} possible six-worders. Some of the possibilities seem unlikely—a book called *A*? or *Kummel*? or *Digitate*? or *How to Digitate a Kummel*? But mainstream literateurs commit a multitude of pretentious sins, and technical writers can force almost any combination of words to make sense.

What is my point? That, on the numbers alone, there can be no excuse whatsoever for duplications of titles until roughly the year 22,081,985! If duplications and near-duplications abound —and they do—that can only be because titles bear meanings they do not take from the dictionary. They express

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ideas, beliefs, dreams, and story types that emerge from a culture.

A case in point: Last year I reviewed John Dalmas's *Touch the Stars: Emergence*. Now I have David R. Palmer's **Emergence**. Both deal in the SF metaphor of the opening chrysalis, sprouting seed, borning babe. Dalmas translated the metaphor as eruption to space. Palmer touches on that idea but adds those of speciation and of leaving bomb shelters. The authors fail to step on each other's toes because their stories are very different and, besides, titles can't be copyrighted.

Emergence is the story of 11-year-old Candy, karate star, obsessive bookworm, and member of the emergent species *Homo post hominem*, whose members never get sick. Her parents are dead, as is her adoptive mother. Her adoptive father is a hot-shot pathologist and government consultant and a honcho in a study of the *post hominems*. Beneath his house is a shelter well stocked with supplies of all kinds, including a wealth of books. And when Papa must rush to Washington, Candy rushes into the shelter, planning to spend the days of his absence buried in words.

But the shelter promptly seals. Alarms go off. Papa's recorded voice says the balloon has gone up. Candy is trapped, safe, until the radiation count dies down. Only then can she emerge, to find a deserted world, bodies on the lawn, and a message from her Teacher, the elderly neighbor who gave her her karate, led her through books, and generally stimulated her development. The message tells her of the *post hominem* study project, tells her where to look for others—who should have survived the biowar plagues—and wishes her luck.

Fortunately, though Candy is young, she is a plucky, self-reliant genius. Off she goes. She acquires a van, builds up the pedals so she can reach them, and starts the search. However, at each *post hominem* home, she finds signs of orderly withdrawal. No one is there. All have vanished somewhere, leaving no traces.

Eventually, she pairs up with a spoiled little rich boy, a horny punster and hot driver, and finds a clue that points to California. Once there, the two of them pick up a mother and daughter and continue the search until an earthquake blocks their path. Candy, reconnoitering in an ultralight plane, has engine trouble, lands on a fallen sequoia trunk, and manages to take off again. She spots a high contrail and follows it to Vandenberg, where she finds the other *post hominems* busily preparing to launch a shuttle to defuse a hellbomb the Soviets left behind to spoil the world for anyone besides themselves. Being the only one who can fit through the access hatch, Candy volunteers for the suicide mission. She has no time to search for her friends, who believe her lost in the forest.

I won't say much about the end, except to tell you that part of it hinges on Candy's pet macaw, Terry Dactyll Foster, and his emerging ability to pick up and parrot Candy's thoughts. Candy and her friends do manage to emerge from a complicated and recomplicated situation whole, despite tragedy that actually brought tears to my hardened eyes.

If the story sounds familiar, that is because its first two sections appeared in *Analog* as "Emergence" and "Seeking." You may recall the style—the entire story, told as Candy's journal entries, is annoyingly and diaristically cutesy-poo, relieved only when Candy's friends take over the narrative chore while she is incapacitated or missing.

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Yet the style works—remember those tears; I for one wound up identifying strongly with the kid—and I give Palmer's book an overall rating of excellent. Buy it. There's a good deal more to it than Stan put in these pages.

Ace Special **Palimpsests**, by Carter Scholz and Glenn Harcourt, is less successful. A palimpsest is a document —originally a parchment—which has been erased and reused. Historians love the things, for with care they can read the erasures and pick up lost fragments of Pliny and Pythagoras beneath a monastery's laundry lists. Yet their work is long, tedious, and boring, and so is *Palimpsests*. The book actually seems, perhaps with some poetically titular justice, twice as long as it is.

The story: Hans Camus, professional student, is himself a palimpsest, with specialty written upon specialty. Currently, he is working to become an anthropologist under media-star Frederick Warner. They are at a dig in Germany's Neander Valley, pursuing routine details until they discover a shiny metal cube that *cannot* have originated in Neandertal times.

So far, so good. From this point the story could have become a very exciting, thought-provoking tale. However, Scholz and Harcourt lose it in a miasma of existential complaint, a fog through which we dimly glimpse the impact of the cube on government agencies and the media. Weak spies help not a bit, and when Camus finally delivers the cube to Warner in Alaska, we are lost for good. Warner has been sucked into Radix Malorum, a totally secret and totally crazy Illuminatus-type science base whose elliptical security chief is named Semimajor Axis. The base uses sensory deprivation tanks to erase personalities, turning Warner and Camus's girlfriend into palimpsests. Camus seems immune, perhaps because he has overwritten himself too often.

Among other things, the base is seeking the secrets of time travel. It finds the cube, with its cryptic recording, a valuable clue. In the end, it transmits the cube back to the Neander Valley, back to the beginning of its circle through time, turning history—and perhaps the human species—into a palimpsest as overwritten as Camus. Our hero, by now little more than a dry pile of eraser dust, relegates himself to the museum where he belongs. And the reader gives one last snore before getting up to find a drink for his parched soul.

Palimpsests is SF, yes. But it is far more an obsessive intellectual game of most interest to its creators, and perhaps to academic critics. Its detailed dissection will necessarily be a great deal more fun than the story itself.

Jeffrey A. Carver's **The Infinity Link** is a long, detailed novel with a mainstream feel. It begins with a mysterious research project where Mozelle Moi, or Mozy, is linked to another person—actually a computer-simulated personality—within a computer. Gradually, it becomes apparent that the study's goal is not simply study of personality but training of the simulation for later transmission by tachyon beam to a spacecraft. The spacecraft is a sophisticated descendant of Voyager *et al.*, its primary mission aborted in favor of rendezvous with an alien craft nearing the solar system.

Link is Mozy's story. She is in love with the simulation, David, whom she believes is real but distant. She prevails upon programmer Hoshi Aronson, who loves her, to transmit her to the spacecraft. She believes she will go in the

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flesh, riding the tachyon beam to a reassembling device and then, finally, being able to see her love face to face, flesh to flesh. It is a shock when she arrives as no more than a disembodied program. The shock lessens when David arrives at last, and it turns to joy when she transfers herself to the alien craft and its biological computers. The shock does not lessen for Hoshi, for her body is left catatonically empty.

Link is also the story of journalist Joseph Payne, who has hints of a blockbuster story but cannot penetrate the secrecy surrounding the project. When he finally succeeds, he is just in time to publicize and block a military gaffe of cosmic stupidity.

Link is also other stories. Other characters play lesser roles. Preludes to the chapters offer glimpses of the aliens' and their songs' impacts on sentients throughout the solar system, from the sun to Earth's seas to Titan and Pluto. The aliens are an intriguing and joyful bunch with their own nobly embracing goals. And the computer, as an environment for live intelligence, is well realized. Carver has joined Pohl and a few other writers in seeing the answer to humanity's dream of immortality that may be emerging from silicon technology, not from the medicine or biology whence it has long been expected.

I enjoyed *Link*. It offers a satisfying and rewarding visionary experience, along with sympathetic characters. However, I did find it rather too drawn out. Carver's constant switching of viewpoints threatens to exhaust the reader's patience. The switching may serve the tradition of cliff-hanger suspense, but to make it work requires hanging the characters from higher cliffs and giving them shorter fingernails. Alternatively, cutting the book by perhaps 20 percent would have speeded the flow of events to a much more pleasing pace.

Ursula K. Le Guin's **The Eye of the Heron** first appeared in *Millennial Women*, edited by Virginia Kidd, in 1978. Harper & Row published a hardcover edition in 1983. Now we have the Bantam paperback, and it's worth a look.

Heron is the tale of a colony on the world Victoria. Its first settlers were South American convicts, sent in one-way spaceships to survive as best they could. They established an urban-based society of macho grandees and sequestered women. Later North America sent a shipload of peaceniks, dedicated to nonviolence, who had defied Earth's devotion to war. Now the two groups are at loggerheads, the People of Peace wanting to move to a distant valley to set up their own independent society, free of the grandees' domination. The grandees, who depend on the peaceniks for food, have no intention of giving up control. Nor do they intend to talk things out as the peacemongers wish. *They* are the Law and the Right, and they will keep their peasants at gunpoint if need be.

Le Guin clearly identifies the ruling and the criminal mentalities. She plays the methods of peace against those of war. Her story is for those who feel SF does not pay enough attention to peace, but its message is not sanguine. The methods of peace cannot succeed unless the exponents of violence have consciences and can be made to feel shame. The best they can do otherwise is destroy their users. It is thus no surprise that the People of Peace must bow.

The one hopeful sign is the defection of the chief grandee's daughter. She, in the end, convinces the peaceniks to defy her folk more actively, by sneaking a

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few colonists away by night. Yet this compromises principles that see anything much more active than passive noncooperation as a form of violence and an invitation to violence. There will surely be war a century later.

John Dalmas's **Homecoming** is a sequel to his first novel, *The Yngling* (*Analog*, 1969), and its last line promises at least one more sequel. Dalmas posits a plague that drives all Earth back to barbarism. Centuries later, Viking-like northerners fleeing their cooling climate confront a cruel society that seems modeled on Tolkien's Mordor, orcs and all. The neoVikings have a few telepaths. Mordor has more, and they rule.

Into this setup comes a starship, a colony's mission to discover why Earth long ago went silent. The starfolk are not telepaths, and they have no least suspicion that such people are possible. They are thus meat for Mordor's pot, and the neoVikings seem doomed once Mordor gets its hands on a flying gunboat.

It takes the telepathic Yngling to save the day. He is a most noble savage, devious but honorable, and his goal is to save his people. He succeeds, Mordor falls, and the starfolk leave. The future, Dalmas promises, holds a rich interaction between Earth and colony.

As I write this, Joseph Delaney and Marc Stiegler have just seen the last segment of their **Valentina** appear in this magazine, not as a serial, but as a string of three novelettes. As you read this, the novel is for sale in book form (and dedicated to Stan). Unfortunately, the novel remains a series of three shorter stories despite a small amount of added bridging material.

Valentina presumes to tell us of the first self-aware computer intelligence. The first segment concentrates on its "ecology," hunting for processors, memory, and information on Worldnet, joining creator Celeste Hackett and Gunboat Smith, and defeating the exploitative lawyer Paul Breckenbridge. Segment two establishes Valentina's sentience in court as the climax of a second fight with Breckenbridge. Segment three develops a way for people to enter Worldnet as computer programs and for Valentina to "execute" on a human brain.

Delaney and Stiegler have developed their ideas carefully and well. Unfortunately, Valentina is their most vivid character. All others suffer seriously from stereotypitis. The book may thus appeal most to computer nuts.

Fred Pohl's *A Plague of Pythons* is now **Demon in the Skull**, revised better to fit the present. Russian scientists have developed a way to transmit mind, to take over a person and make him or her do whatever the transmitter wishes. The technicians have used the device to overthrow their masters, destroy all nuclear arsenals, and bring the world to a standstill. Some of them are sadistic beasts who love to use their puppets to rape, murder, and despoil. The world's people know not who their masters are, but they adapt as best they can. They forgive puppet sins, and they condemn out of hand anyone they suspect of pretending to be possessed. Chandler is such a suspected hoaxer.

Yet Chandler was truly a puppet in his moment of abomination, and his unjust punishment motivates him as events bring him face to face with the puppet masters. He learns their motives, which are not totally bad, and their technology. He brings them down, and then he faces the prospect of throwing away

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the reins of godlike power. The temptation is irresistible.

Pohl tells his story well, as we might expect, but he has done better and more thoughtful work. The biggest defect here may lie in his portrayal of the gimmick, for it is basically a radio transmitter, not a receiver, yet a puppet master transmits not only orders but also awareness. Pohl's science is more than usually gobbledygook.

Another large defect lies in the cover artist's depiction of Pohl's face: Don Maitz has drawn a head whose chin says, "Straight up!"; however, the head is cocked jarringly to one side. I suspect a low art budget and a hasty schedule.

M. A. R. Barker is a University of Minnesota language professor who has designed the role-playing game world of Tekumel, complete with unwieldy, reader-boggling tongues. He is also a "DAW Superstar" and the author of **The Man of Gold**, a Tekumel quest novel. Priestlet Harsan, specialist in dead languages, must find the artifact of a lost civilization, the Man of Gold, to defeat dread evil and save his world and all the universes. He faces plots, intrigues, and monsters in obsessively grotesque detail,and the yawning reader has an awful chore to follow him all the way. The worst problem is the tale's dearth of life—languages, civilizations, characters, and motives are all dead. I hope Barker's game is more interesting.

"H. M. Major guards his privacy jealously . . . favorite sports are archery and fencing, which he feels has been spoiled by the use of blunted foils . . . lives alone except for a temple-trained Siamese guardcat. And where he lives is not really known, but is probably not in the States." The name is an obvious pseudonym, probably standing for a packager's stable of house writers. Yet the flavor of the author's description carries over to the novel: **The Alien Trace**, a saucily tongue-in-cheek "adult" SF novel.

Trace gives us a world of empaths where crime is rare but bounty-hunting Catchers like the hero, Cord, are occasionally necessary. When humans come, so does a shape-changing murderer, and Cord pursues the villain off his planet and into the galaxy. He doesn't catch up, but that is *de rigueur* for the first novel in a series.

What makes *Trace* "adult" is Cord's tail. It is long, prehensile, and sensuously talented, and his people's first reaction to humans was, "Poor people! How their sex lives must suffer!" It's nice, horny stuff. However, it's not much as novels go. The characters are too thin, the aliens too human, and the tale itself all action. *Very* light reading.

Dennis L. McKiernan's **The Dark Tide** is the first of three volumes to rerun Evil Modru, aka Sauron, versus the Warrows, aka hobbits. It's a pale and magicless imitation of Tolkien, and the differences are minor. The Warrows have hairless feet and wear shoes. The Shire is the Dells, a small land bounded by a thick and thorny hedge. The Ring is only Modru's banner emblem. Mordor's heat turns cold. Strider is Galen (note that the name is that of a classical healer). And so on. The quest to free the Lady Laurelin from the Iron Tower and kill Modru with relics of another age will have to continue without me. I will neither read nor review the next two volumes, *Shadows of Doom* and *The Darkest Day*.

Jack L. Chalker's **Spirits of Flux and Anchor, Book One: Soul Rider** offers an intriguing world. Ages after human-

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ity's arrival by starship, the world is a checkerboard of solid land, Anchor, where people live, farm, and breed, and chaos, Flux, where adepts shape raw energy to their liking and rule lesser talents and slaves. Cassie is to be a slave, culled from her Anchor haven as surplus population, but her mind contains a Soul Rider, a being whose mission it is to combat the forces of evil. She helps save the caravan, is freed, and begins to become a force in the struggle.

Chalker sets up some lovely, fascinating frames for his long novels, and he peoples them with interesting characters as well as hordes of spear-carriers. I wish he would use them to better effect. As is, we get only glimpses of thoughtfulness or social comment —culling *is* the only logical way to cope with unrestrained fertility. As a whole, the tale makes no point nontrivial enough to justify its length. Its greatest virtue, especially by comparison to McKiernan's book, is its originality.

In **The Clarion Awards**, Damon Knight has drawn together 14 original stories from 1976–1982 Clarion workshoppers who had not yet published any short fiction by the time of his announcement letter. Some of the contributors have thus become familiar to us already in other pages. Lucius Shepard stands out as the paramount example; his "The Etheric Transmitter," whose end sees the Eiffel Tower evaporate, won the $200 first prize in the Awards competition. Many of the stories have little to warrant any serious attention, though perhaps they promise future greatness. My favorites are Shepard's, Dean Wesley Smith's short-short "Flawless Execution," Kristi Olesen's "Beast and Beauty," and Nina Hoffman's "Lost Lives." ■

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KATHY TULLY-CESTARO
CIRCULATION DIRECTOR, SUBSCRIPTIONS

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brass tacks

Dear Stanley Schmidt,

One of our readers just sent to me, and I read with great interest, your editorial in the July *Analog*. ("Educational Mythology")

As a result of my work as an elementary and secondary school teacher, and of my experience observing and interacting with infants and very young children, I came to feel around 1960 that the myths you name were in fact widely held and very damaging, and through my books *How Children Fail*, *How Children Learn*, and numerous later works, and in hundreds of talks to educators, began to try to combat and overcome those myths. As nearly as I can tell, the schools cling to them more stubbornly than ever.

Along the way I discovered that what you are now saying, and what I have been saying for about 25 years, people were saying long before we were born. What I—and I think you—would call sound and realistic principles of education were practiced on a city-wide scale in the schools of Gary, Indiana in the year 1905, and in the schools of Quincy, Massachusetts in the year 1865. Bronson Alcott was using them in the education of his own children as far back as the 1820's.

John Goodlad, Dean of the School of Education of UCLA, says in his latest book *A Place Called School* that the schools have not changed in any important respect since the turn of the century—and he might as well have said, since the middle of the last century. They have always run on the myths you list, and on the underlying myth that knowledge is a kind of substance and teaching the art or act of pouring it from full vessels into empty ones. As long as that idea keeps its grip, and there is no sign of its losing it, the schools will not get better.

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I still talk to educators when they ask (and pay) me, but I have no hopes of seeing any significant change in schools in the rest of my lifetime (barring war, around thirty years). Most of my efforts now go into helping those who for various reasons wish to teach their own children at home. This is a small, growing, and I think very significant movement in education. If this is something that you and/or some of your readers would like to know more about, feel free to drop me a line.

JOHN HOLT

Growing Without Schooling
729 Boylston Street
Boston, MA 02116

Dear Stan:

Your editorial, "Educational Mythology," in the July 1984 issue was a valuable contribution to the growing national debate over education. I'd like to add a few thoughts:

1. It is vitally necessary to keep as low a ratio of students to teachers as possible. Nothing else, I think, is so important as giving each student as much of the teacher's undivided attention as possible. Some day the "teacher" may be a very flexible and clever interactive computer program. But for the present, the best way we can spend tax dollars on education is to hire as many of the best teachers possible. We don't need buildings and administrators as much as we need *teachers*. Good education can (and has) taken place in private homes, in cellars, and even in groves of trees.

2. Good teachers are those who have some knowledge to impart to their students. Most graduates of teachers' colleges have neither academic nor practical knowledge of any subject except "education." They are empty vessels, and hiring them to teach the young simply produces even emptier vessels.

3. Proposals to spend more money on education without totally restructuring the nation's public educational systems are simply proposals to reward the people who have created the problem! This is rather like increasing the salaries of incapable workers in the hope that more money will make them wiser or more skillful. It won't.

'Nother subject. I have a bone to pick with you and Grant Callin. I read "Saturn Alia" expecting to find at least a glimpse of the aliens who left those artifacts. Instead all I got was a discourse on space navigation and some pretty forced "conflict." The characters were fresh and fascinating, the story's basic premises were good—but it's still a shaggy dog tale and a great disappointment. Callin promised us aliens and you let him get away without delivering. I certainly hope you make him finish what he's started!

BEN BOVA

Stanley Schmidt:

You missed at least one myth: *schools can do it all*. Educators are in part responsible for that myth. We really thought we could, and we sold that bill of goods to eager parents. Some of us still do. So we now have parents afraid to take an active part, and we have students who think that no effort should be required of them

I hear regularly the complaint that "I really wanted to learn subject, but the teacher was so bad I didn't." This from college students with an adequate text and a good library.

A mother complains that she has just found out the schools have not taught her seventeen-year-old to read adequately. She wants me to join her in blaming the school. Instead I ask where

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she has been for seventeen years. She writes me off as another incompetent educator.

Somehow we have got to make the education of our children a team effort with family, child, and school working together. That's obviously not *all* we have to do, but it is a necessary step.

I had the opposite problem in gym classes, but I can sympathize with the lack of individual treatment. The kids who needed help got none; the kids who needed gym like another elbow had to take it anyway. My heresy has been to advocate annual testing of ability so that kids who need help get it in a small group (made possible by the fact that kids who do not need gym are getting some other educational experience). Personally, I could have benefitted a great deal by the simple substitution of library time, or about six other subjects, for gym.

There is a note you should have played that I missed: optimism. As I write it occurs to me that education has never been perfect and never will be; and any of us can point to errors we made or that were made to us, but somehow or other a lot of us do pretty well anyway. Humans seem capable of overcoming a great deal, even the stupidity of other humans or the foolishness of themselves (I'm a high-school dropout with a Master's Degree).

HAROLD ETTELT

Hudson, NY

Actually I didn't miss your additional myth, but devoted a whole separate editorial to it back in November 1983 ("Placing the Blame").

Dear Ms. Frier:

Thank you for permission to duplicate and distribute copies of "Educational Mythology" to my fellow members of the Roxbury Township Board of Education and the central office administrators. I have, in the past, referred to Mr. Schmidt's editorials on this topic as breaths of fresh air; the voice of someone who cares deeply about education and who speaks from outside the system—sparing us the jargon and institutional dogmatism characteristic of "official" materials about education.

Though I often disagree with his editorial positions, I seldom, if ever, have found them lacking thought. This editorial is thoughtful, thought-provoking, and internally consistent with the highest educational ideals. It raises questions, defines them, expresses some possible answers, and leaves it to the student (reader) to take a position and act on it.

CHARLES H. COLLINS, JR.

Kenvil, NJ

Dear Mr. Schmidt,

As a teacher, I would like to thank you for your editorials this year dealing with education. You have been right "on line" with your ideas. Your ending to "A Carrot for the Teacher" is exactly true. You should have been stronger to indicate that encouragement can come from your readers. In my own case, the administration view me as a prickly pear! I continue to risk their possible wrath because former students and parents tell me how I have helped them. I am definately a Type I, but I can be because my husand is a Type II. Actually he isn't a Type II but what he does for a living pays significantly better than teaching.

Every year I pick some kind of theme and arrange my work for the students around it. (Even math works this way but not as easily as reading or other subjects.) This year teaching seventh grade math and one section of reading I decided to focus on "crisis management."

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I feel that is one of America's problems. The educational system does not teach thinking ahead. "We" only want the one "right" answer. I used your editorial about King Impervius for an introduction of the idea. I read the editorial and we had several discussions about the responsibility of becoming informed voters. With the top groups we also discussed the role of the "expert" and the fact that many "experts" become narrow-minded to their field.

I am leaving the field of teaching for awhile. One reason is that we are moving to another state and I will probably not be qualified in that state. When I moved to Alabama I had to take a whole year's worth of undergraduate classes just to teach.

The other reason I am not working is that I want to write about my methods of teaching and do research. I am very curious about the development of a sense of humor.

I would like to make a suggestion for future editorials. I am committed to the development of future generations, especially of bright children, because the power base in the country in the Information Age will be the developed brains of the people. Many educators are studying the development of talent. Among these eminent individuals is Dr. Benjamin Bloom. His research is on living individuals and my research over the last fifteen years from biographies includes the living and dead. Our research uncovered some common themes. The development of talent takes three stages: The Family, local teachers, and super teacher or mentor. An editorial on this subject might encourage a young person to seek a mentor and your older readers to realize that public schools can't do it all. Of course you can find Dr. Benjamin Bloom's work in the November 1981 *Educational Leadership* and *Phi Delta Kappan*, June 1982.

Science fiction is very important in the educational system because it has children break out of the "rules" while reading, and become futuristic thinkers. I believe visual thinking about the future helps it become what you wish. Thank you for your editorials and for the magazine.

MS. THOMAS A. FAIRWEATHER
1983 Alabama Teacher of the Year
President of Alabama Association
for Gifted and Talented

Dear Mr. Schmidt:

Re your editorial in the July issue of *Analog*: BRAVO! It's too bad that your message won't be acted upon, but nothing ventured, nothing gained, as the old saw goes. I do have a couple of reactions to what you say that I'd like you to consider:

(1) I like what you say. I agree almost totally (more about this in point 2 later). Now why don't you take the next major step? At this point you've extracted some 15 points that desperately need to be addressed. Now why don't *you* address their solution(s)? The point I'm making is that it is very easy to be *critical* (and heaven knows *constructive* criticism is badly needed), but now put your sagacious mentality to work to devise, at least at this point, some beginnings. I feel somewhat keenly about solutions because for the past 15 years I had been teaching in a library school where one of my colleagues had constantly harped on the wrong-wayness that library education has been going, particularly in the program in which we were involved. I finally got up the guts to tell him to propose some solutions; sit down and write up a curriculum that would satisfy his gripes. (Please believe me when I say that I

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believe him to be correct; librarians [i.e., library educators] address the wrong approach in what [and how?] they teach—I think this is one broad sweeping generalization that is mostly true!) But he backed off, stating that his function was not that of a solver but rather of continuing to attempt to point out the error of the library educators' ways. And without doubt that point of view has validity, but I also think the time comes to "put up or shut up."

(2) Re your point 14: "Continuous practice is necessary to develop and retain any skill." Perhaps your definition and mine of what a "skill" is differ. I defy *anyone* to take a couple of years of piano lessons, practicing diligently, lay off for say five, maybe even one year, and then come back and play as well as had been done at the end of the first year or two. I will grant the validity of laying aside a problem for a few days, then coming back to it, and, lo, the answer seems to come. I've had that happen to me, and you've implied that it has to you as well. And I will grant the bit about the curriculum from grades 4–8 which seem to be endlessly repeated, with just a little new each year; that seems to me to be waste of time, too, but I would like to know of some *explicit* examples of skills that you have had, that you did not use for ". . . lapses of several years . . ." and then ". . . come back in some ways *better* [italics yours] than they had been before."

I would have also added point 16 (I don't know quite how to title this one succinctly, but you'll get the point easily): some teachers and some students just aren't compatible. If student A were switched to teacher B, he might do very much better than with teacher A. I've certainly had that happen to me: I have some students who swear that I'm one of the best teachers they've ever had; others who can't stand the sight of me. It's too bad that these kinds of relationships can't be discovered early in a school year, and get the kid transferred to someone with whom he can relate.

Thanks for letting me "bend your eye."

MERLE LAMSON

Woodland Hills, UT

(1): The trouble is that the myths I cited are not really difficulties with teaching; they're myths *which* create *difficulties with teaching. They're things that people believe, despite evidence all around that they're wrong. I've cited some of that evidence, as well as what I found worked better than these wrong assumptions. But all my points reflect only one central problem:* not *to design a better curriculum, but to overcome the misconceptions of the people who are in a position to do that and keep imposing inane ideas on teachers. The only solution I've ever found, as a teacher, is to do things my way instead of theirs. At a small private college I could do that; in most public schools I couldn't. And that* should *suggest a solution—but getting anybody to act on the suggestion is like pulling teeth with eyebrow tweezers.*

(2): I don't think our definitions of skills are so different; my personal examples include playing several musical instruments, speaking Spanish, and flying an airplane. Please note carefully that I did not say your hypothetical piano player would immediately *start playing as well after a five-year lapse as he did at the end of two years of regular practice. Of course he'll have trouble at first—but I wouldn't be at all surprised if it only took him a couple of weeks of conscientious work to re-establish and even surpass the proficiency he had when he quit. I won't even claim it*

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works that way for everybody, but I know, from quite a few examples, that it works for at least some people.

Dear Mr. Schmidt:

Your July issue came in a few days ago. May I say a few words about your editorial.

Our social structure is set up to reward the person who can command the most people or who can command the most money. In the educational structure there is no reward as such for doing a good job. The educator who is able to teach has no sure reward for doing so. The person who can get the most money and people for his projects becomes the leader in the field. So any teacher, politician, or bureaucrat with any real understanding of our society stops wasting time teaching or producing. That's not where the prestige is. Get a bigger budget for the handicapped, or the disadvantaged, or the students who don't speak your language. Get a bigger budget for buses, get a bigger school (even though you have fewer students), spend-spend-spend . . . your pay and your prestige depend on it.

The same problem exists in all our social organizations. What happened to the person who put together the Washington State atomic plant failure? How many of the people responsible for Three Mile Island lost anything? In my neighborhood the authorities have spent over four million dollars on security for two or three people accused of murdering a bank guard. The idea remains the same in all cases. If you want money and prestige, you must spend money (not your own of course) and have people under you. Teaching the students has nothing to do with it.

Some teachers never learn. They keep on trying to teach.

Possible solutions? How about this: all the elected officials receive no pay for the balance of the year whenever they are over the budget? At least we can stop rewarding the decisions that are rewarding the spenders.

PAUL J. FRANZEL

New City, NY■

● Ecology is the study of the economy of living things; the interrelationships and interdependencies of life forms. All living things constitute a planetary organism, in a sense. Man sprang from the living forms of Earth; he is still a part of the system.

The overall evolutionary mechanism is that *Man is creating a planetary organism in which animal forms and plant forms cooperate in mutual survival, instead of individual survival.* The liver cells of an animal are incapable of surviving alone, as their remote, ancestral forms did. Man is in process of creating a world-organism of life forms that are similarly incapable of independent survival. John W. Campbell

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a calendar of analog upcoming events

1-3 February
OMNICON (South Florida regional SF conference) at the Miami Airport Hilton, Miami, Fla. Guest of Honor—Theodore Sturgeon, Artist Guest of Honor—Michael Whelan, MC—Nicholas Courtney, Guests—John Nathan-Turner, Somtow Sucharitkul, David Kyle. Film/video competition. Art show, films, etc. Registration—$23.50 (2 days), $26.50 (3 days) until 30 November, more thereafter; buffet tickets available to 3-day ticket holders for $20. Info: Omnicon, Box 970308, Miami FL 33197. 305-253-6842.

1-3 February
TAKE MY CON . . . PLEASE (Humor-oriented SF conference) at Sheraton Northwest, Silver Spring, Md. Guest of Honor—Diane Duane, Artist Guest of Honor—Phil Foglio. Registration—$10 in advance. Info: W.A.C.O., Box 335, Arnold MD 21012.

15-17 February
BOSKONE XXII (New England regional SF conference) at the Boston Marriott, (Copley Place) Boston, Mass. Guests of Honor—Damon Knight and Kate Wilhelm. Artist Guest of Honor—Carl Lundgren. Special Guest—Shawna MacCarthy. Registration—$17 until 12 January 1985, $22 at the door. Art show, hucksters room, etc. Info: Boskone XXII, Box G, MIT Post Office, Cambridge MA 02139.

22-24 February
WISCON 9 (Wiscon area SF conference) at Concourse Hotel, Madison, Wisc. Guest of Honor—Alicia Austin and Lisa Tuttle. Registration—$13 until 31 January 1985; $18 at the door. Info: SF**3, Box 1624, Madison, WI 53701-1624. 608-251-6226 (days), 608-233-0326 (evenings).

25-28 February
Compcon Spring 85 (IEEE Computer Society Conference) at San Francisco, Cal. Theme—Technological Leverage: A Competitive Necessity. Info: Glen G. Langdon, Jr., IBM dept K54/282, 5600 Cottle Road, San Jose CA 95193, 408-256-6454.

22-26 August 1985
AUSSIECON II (43rd World Science Fiction Convention) at Southern Cross Hotel, Melbourne, Victoria, Australia. Guest of Honor—Gene Wolfe, Fan Guest of Honor—Ted White. Registration—$30 supporting; $60 attending (more at the door). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: Aussiecon Two, GPO Box 2253U, Melbourne VIC 3001, Australia (use airmail); Fred Patten, 11863 West Jefferson Blvd. #1, Culver city CA 90230 (membership info); jan howard finder, Box 428, Latham NY 12100.

30 August-2 September 1985
NASFiC 1985 (North American SF Convention, officially The First Occasional Lone Star SF Convention & Chili Cook-off) at the Hyatt Regency Austin and Palmer Auditorium, Austin, Texas. Guest of Honor—Jack Vance, Artist Guest of Honor—Richard Powers, Fan Guest of Honor—Joanne Burger, TM—Chad Oliver. Registration—attending $35 until 31 December 1984, then $45; supporting—$15. Info: NASFiC, Box 9612, Austin TX 78766.

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.

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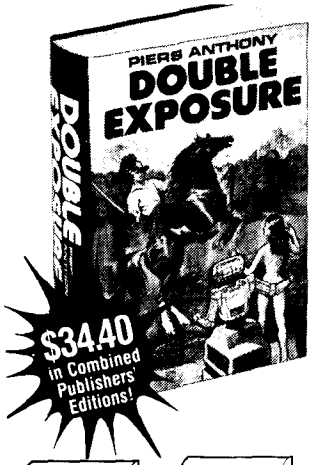

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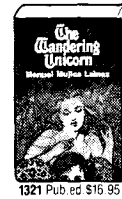

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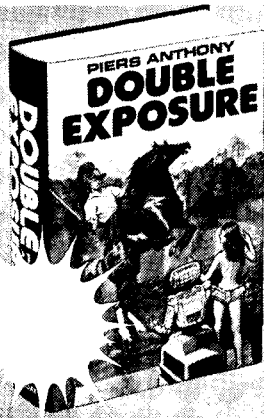

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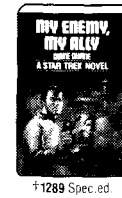

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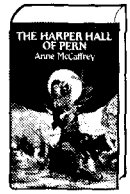

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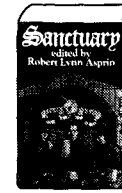

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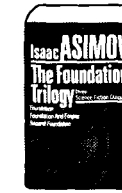

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